

two or three locations. The noise levels of all locations are above permissible limit 65 dB (A) except Bhangagarh site during 7:00 am to 8:00pm. This due to all types of crowded vehicles mostly commercial, narrow roads and poor traffic management<sup>14</sup>

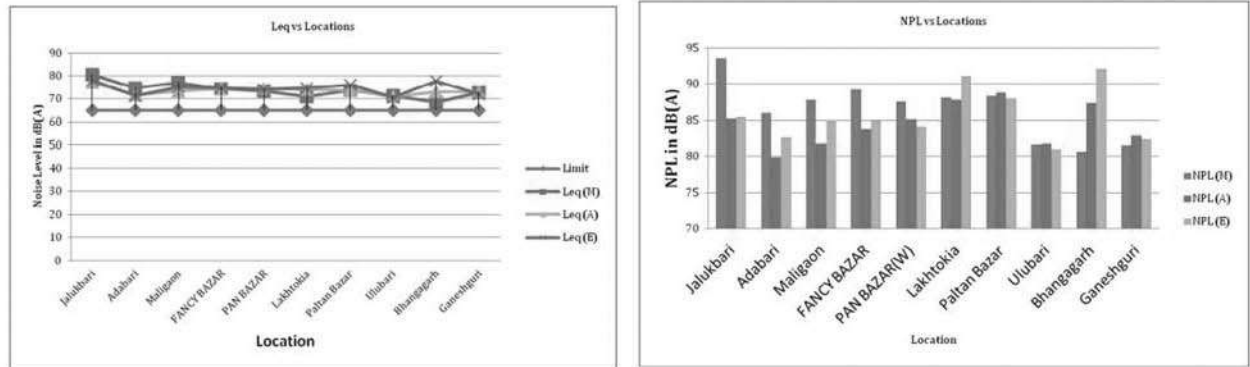


Figure 10-50: Noise Levels (Leq) in some Commercial locations (left); Noise Pollution Level (NPL) in some Commercial locations (right) in the Guwahati city

Noise Pollution Level (NPL) gives an idea of noise pollution caused by fluctuating noise level. The average Noise Pollution Level (NPL) varies in the range of 78.68 dB (A) to 93.56 dB (A), 71.68 dB (A) to 88.82 dB (A) and 68.45 dB (A) to 92.19 dB (A) during 7:00 am to 10:00 am, 12:00 noon to 3:00 pm and 4:00 pm to 8:00 pm respectively<sup>5</sup>

### 10.8.3.2 Noise level in Residential areas

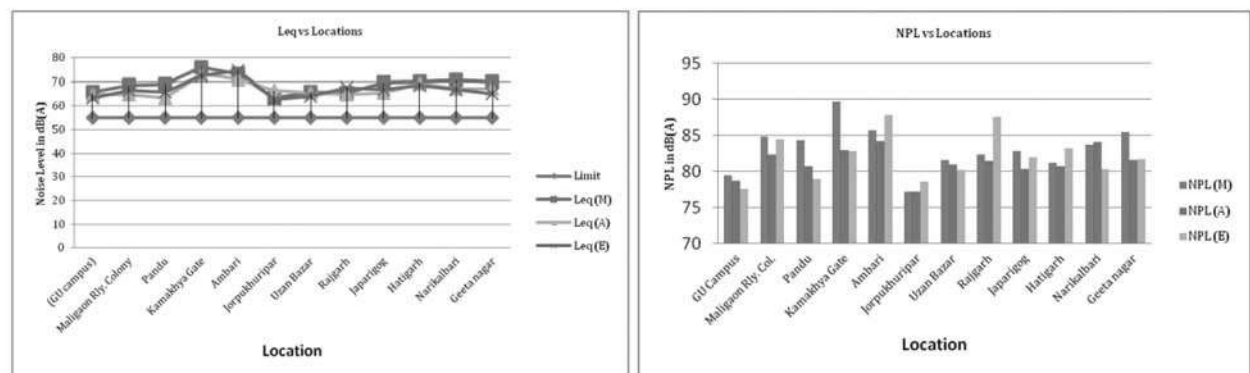


Figure 10-51: Noise Levels (Leq) in some residential locations (left); Noise Pollution Level (NPL) in some residential locations (right) in the Guwahati city (Md. Sayeedul Islam, 2017)

Residential areas of Guwahati city have shown higher noise levels than the prescribed noise standard 55dB (A). Some of the residential locations situated nearby roadside show noise levels more than 70 dB (A). The average Noise Pollution Level (NPL) of some residential area in the Guwahati city varies in the range of 77.29 dB (A) to 89.69

<sup>14</sup> Md. Sayeedul Islam, Dr. Kalyan Kalita, 2017, Assessment of Traffic Noise in Guwahati city, India, International Research Journal of Engineering and Technology (IRJET)

dB (A), 77.27 dB (A) to 85.59 dB (A) and 77.66 dB (A) to 87.85 dB (A) during 7:00 am to 10:00 am, 12:00 noon to 3:00 pm and 4:00 pm to 8:00 pm respectively (Md. Sayeedul Islam, 2017).

### 10.8.3.3 Noise level in Silence areas (Educational and Hospital Zones)

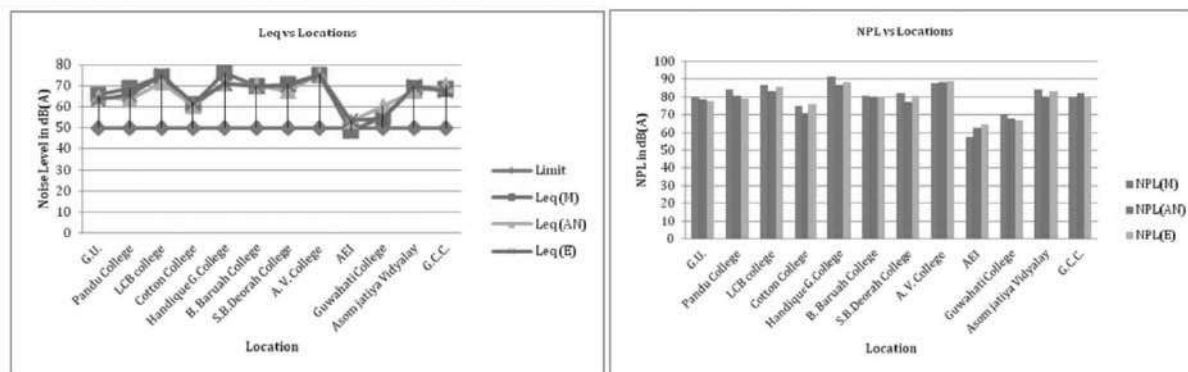


Figure 10-52: Noise Levels (Leq) in some Educational Institute locations (left); Noise Pollution Level (NPL) in some Educational Institute locations (right) in the Guwahati city (Md. Sayeedul Islam, 2017)

It has been observed that the variations of noise level, Leq in some educational institutions of the city is ranged from 48.68 dB (A) to 76.0 dB (A) with standard deviation 6.8 ; 53.23 dB (A) to 75.7 dB (A) with S.D. 5.7 ; and 53.54 dB (A) to 75.83 dB (A) with S.D. 6.8 during 7:00 am to 10:00 am; 12:00 noon to 3:00 pm and 4:00 pm to 8:00 pm respectively. The average Noise Pollution Level (NPL) in some educational institution premises in the Guwahati city varies in the range of 57.68 dB (A) to 91.6 dB (A), 62.73 dB (A) to 88.4 dB (A) and 64.74 dB (A) to 91.1 dB (A) during 7:00 am to 10:00 am, 12:00 noon to 3:00 pm and 4:00 pm to 8:00 pm respectively.

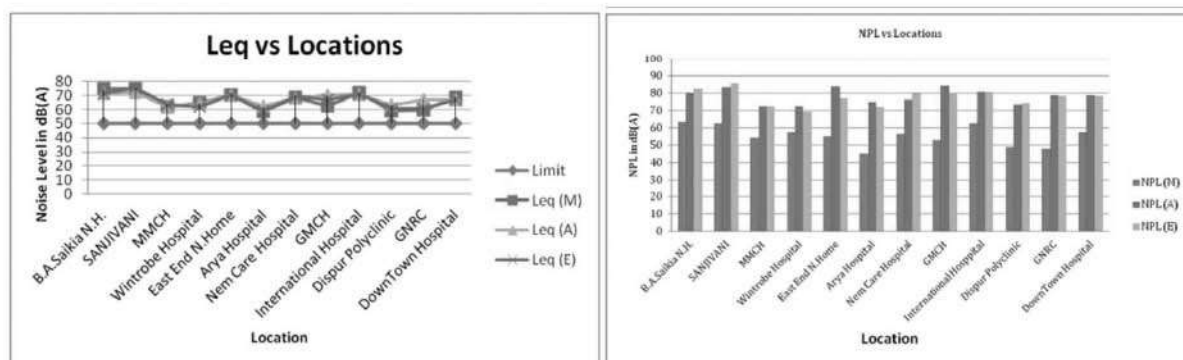


Figure 10-53: Noise Levels (Leq) in some Hospital locations (left); Noise Pollution Level (NPL) in some Hospital locations (right) in the Guwahati city (Md. Sayeedul Islam, 2017)

The noise level at some hospitals and nursing homes in the city is varied in the range from 58.6 dB (A) to 74.74 dB (A) with standard deviation 5.6; 59.8 dB (A) to 74.12 dB (A) with S.D. 4.1; and 59.1 dB (A) to 75.24 dB (A) with S.D. 4.9 during 7:00 am to 10:00 am; 12:00 noon to 3:00 pm and 4:00 pm to 8:00 pm respectively. The Noise

Pollution Level (NPL) of some hospitals and nursing homes in the Guwahati city varies in the range of 45.1 dB (A) to 63.4 dB (A), 68.2 dB (A) to 90.4 dB (A) and 68.1 dB (A) to 89.1 dB (A) during 7:00 am to 10:00 am, 12:00 noon to 3:00 pm and 4:00 pm to 8:00 pm respectively. Most alarming situation is with high noise levels in the silence zone of the city. According to "The Noise Pollution (Regulation and Control) Rules, 2000, the silence zone is an area comprising not less than 100 meters around hospitals and educational institutions. But from this study, it has been found that most of the hospitals, Nursing homes and educational institutions are established in either commercial places or nearby heavy traffic plying roads. Consequently, most of the hospitals, Nursing homes and educational institution premises are in the grip of higher traffic noise levels than the prescribed noise standards of 50 dB (A) and they are not safe from noise induced disturbances (Md. Sayeedul Islam, 2017).

#### **10.8.4 Air Pollution**

Air pollution is considered to be primarily an urban problem in Guwahati city as the rate of urbanization increases. Growing air pollution has emerged as a serious concern in the city with vehicular emission and dust contributing a major share of the deteriorating air quality.

In rural areas, air quality is considered to have been negatively affected with areas adjacent to industrial estates or isolated industrial plants set up outside city limits. The notion of maintaining good air quality has been the focus of attention among concerned stakeholders in Guwahati. The Pollution Control Board, Assam (PCBA) has been monitoring the city's ambient air quality under the National Air Quality Monitoring Programme (NAMP) and has recorded high levels of air pollution in all its monitoring stations in the city.

Under N.A.M.P., four air pollutants namely, Sulphur Dioxide (SO<sub>2</sub>), Nitrogen dioxide (NO<sub>2</sub>), Suspended Particulate Matter (SPM/ PM<sub>2.5</sub>) and Respirable Suspended Particulate Matter (RSPM/ PM<sub>10</sub>) have been identified for regular monitoring at all the locations.

The problem of air pollution in the Guwahati city is mainly because of vehicles and small and medium-scale industries. With more and more people these days purchasing private vehicles, the energy consumption (fossil fuel) and SO<sub>x</sub>, NO<sub>x</sub> emissions have increased tremendously. According to reports, more than 400,000 vehicles ply on Guwahati's roads every day and approximately 70% of these vehicles

don't have emission clearance certificates. So, majority of the vehicles plying on Guwahati roads could be emitting excessive amounts of toxic pollutants. The other reason which is affecting Guwahati city is unplanned and open burning of solid waste disposal right in the city itself.

Presently in Guwahati total six Air Quality Monitoring Stations are located at various locations such as- Bamunimaidan, ITI College, Boragaon, Khanapara, Shantipur, Guwahati University. The following map illustrates the location of these six monitoring stations.



Figure 10-54: Air Quality Monitoring Stations in Guwahati

The Following tables provides the details of the components used to measure Air quality data of all six locations during the months April, May and June.

Table 10-38: Air Quality Data of Guwahati during April 2019

Parameter	Bamunimaidan	ITI College	Khanapara	Shantipur	Guwahati University	Boragaon
SO <sub>2</sub>	16	8	8	7	8	7
NO <sub>2</sub>	18	18	18	17	18	18
PM <sub>10</sub>	101	167	84	100	85	97
PM <sub>2.5</sub>	54	68	45	52	46	52
CO	0.743	--	--	--	--	--
O <sub>3</sub>	47.21	--	--	--	--	--

(Source: Pollution Control Board, Assam, 2020)



Table 10-39: Air Quality Data of Guwahati during May 2019

Parameter	Bamunimaidan	ITI College	Khanapara	Shantipur	Guwahati University	Boragaon
SO <sub>2</sub>	12	7	6	7	7	6
NO <sub>2</sub>	15	16	16	16	17	15
PM <sub>10</sub>	62	81	50	61	49	67
PM <sub>2.5</sub>	31	36	28	31	26	34
CO	0.5429	--	--	--	--	--
O <sub>3</sub>	50.74	--	--	--	--	--

(Source: Pollution Control Board, Assam, 2020)

Table 10-40: Air Quality Data of Guwahati during May 2019

Parameter	Bamunimaidan	ITI College	Khanapara	Shantipur	Guwahati University	Boragaon
SO <sub>2</sub>	10	7	7	7	7	7
NO <sub>2</sub>	14	15	15	15	14	14
PM <sub>10</sub>	65	64	59	62	45	46
PM <sub>2.5</sub>	28	32	26	32	25	26
CO	0.5829	--	--	--	--	--
O <sub>3</sub>	29.66	--	--	--	--	--

(Source: Pollution Control Board, Assam, 2020)

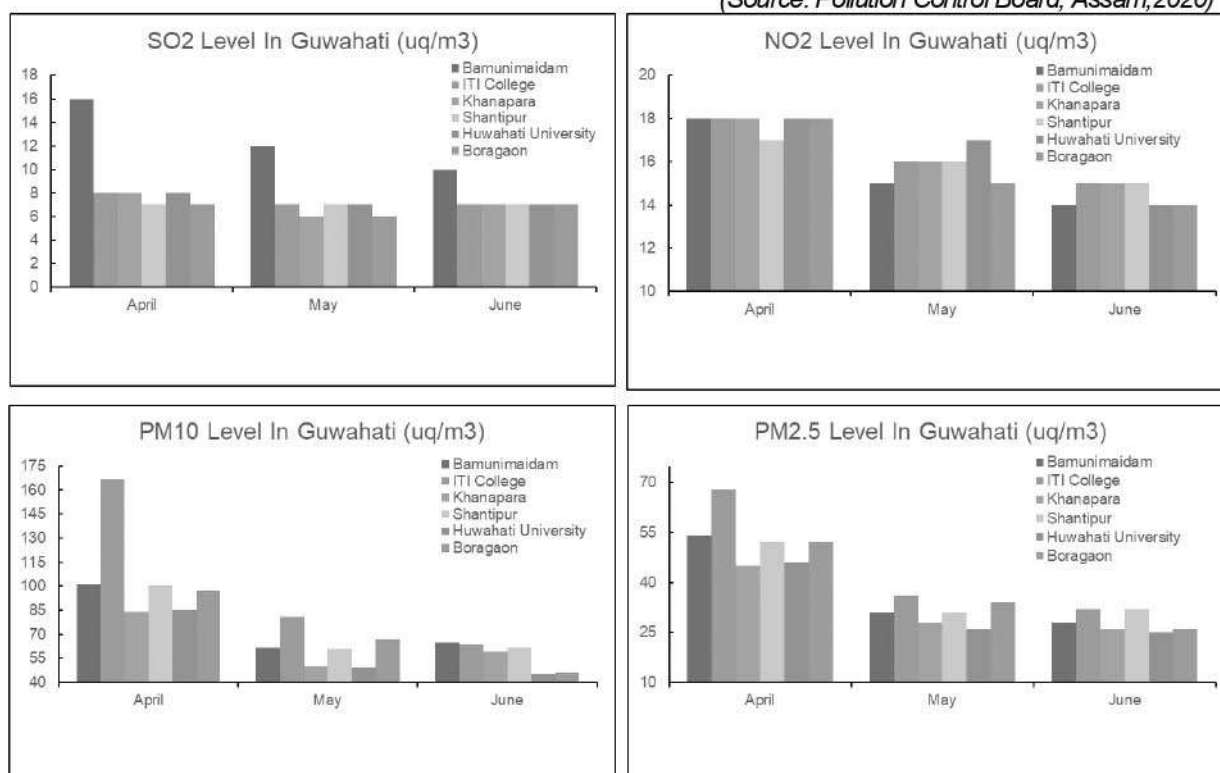
Figure 10-55: Analysis of SO<sub>2</sub>, NO<sub>2</sub>, PM<sub>10</sub> and PM<sub>2.5</sub> levels at various locations during the months April, May, June

Table 10-41: Break Point Pollutant Concentration for Indian Air Quality Index

Sl. No.	Category	SO <sub>2</sub>	NO <sub>2</sub>	PM <sub>2.5</sub>	PM <sub>10</sub>
		(µg/m <sup>3</sup> )	(µg/m <sup>3</sup> )	(µg/m <sup>3</sup> )	(µg/m <sup>3</sup> )
1	Good	0-80	0-80	0-200	0-100
2	Moderate	81-367	81-180	201-260	101-150
3	Poor	368-786	11-564	261-400	151-350
4	Very Poor	787-1572	565-1272	401-800	351-420
5	Severe	>1572	>1272	>800	>420

(Source: CPCB)

As per the data available it is found that SO<sub>2</sub> level at all locations in all three months were below 80 means the level is in good category. However, the SO<sub>2</sub> value at Bamuni maidan remained on higher side compared to other five locations. Similarly, NO<sub>2</sub>, PM<sub>10</sub> and PM<sub>2.5</sub> level found to be good within Guwahati. At ITI College the value of PM<sub>10</sub> and PM<sub>2.5</sub> found higher than other locations.

## 10.9 Environmental Strategies

In order to mitigate the above-mentioned environmental issues, few proposals have been given in GMP - 2045, which is an effort to protect the environment of the region.

### 10.9.1 Protection of Water Bodies, Water Channels and Drains

Water is the most precious gift of nature. Today, both surface and subsurface water in India and other South Asian cities is facing huge quantity and quality threat. Thus, it is crucial to protect the available source of water i.e. rivers, wetlands, ponds, water channels etc. These waterbodies not only provide drinking water, support livelihoods and biodiversity but also control the rate of runoff and subsequently control the runoff. Guwahati Region has four notified wetlands under The Guwahati Water Bodies (Preservation & Conservation) Act 2010 namely, Deepor Beel, Bondajan Beel, Silsako Beel, Sarusala & Borsola Beel. Guwahati blessed with the three major rivers and its tributaries passing through Guwahati which are Brahmaputra, Bharalu & Basistha. Considering the ecological importance of this waterbodies few proposals are given, which are given below.

**10.9.1.1 Deepor Beel**

**Name:** Deepor Beel (The only Ramsar Site of the State)

**Area:** 10 sq.km. (Full tank capacity in winter)

**Description:** The Environment (Protection) Act, 1986, The Wildlife (Protection) Act 1972, Guwahati Water bodies (Preservation and Conservation) Bill, 2008

Deepor Beel is a permanent freshwater lake, in a former channel of the Brahmaputra River, to the south of the main river. It is also called a wetland under the Ramsar Convention

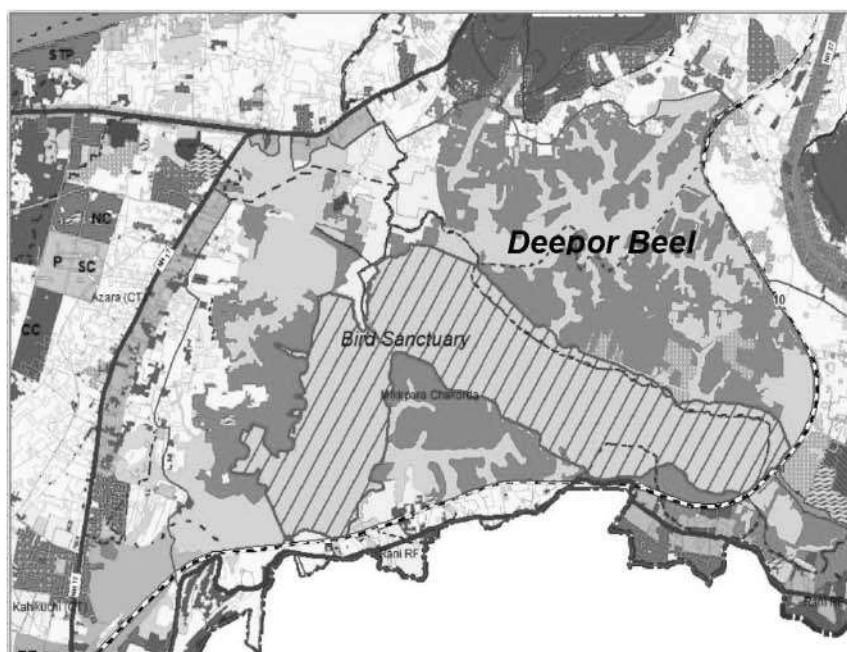


which has listed the lake in November 2002, as a Ramsar Site for undertaking conservation measures on the basis of its biological and environmental importance. This Wildlife Sanctuary located in the south-western side of Guwahati city in Kamrup (Metropolitan) district of Assam and the only Ramsar site in the State, is one of the largest freshwater lakes of Assam, which extends up to 30 square kilometer in the summer and reduces to about 10 square kilometer in the winter, of which an area of 4.1 square kilometre has been notified as Wildlife Sanctuary as per the Govt. Notification no.FRM.140/2005/260, dated 21<sup>st</sup> February, 2009.

Therefore, Ministry of Environment and Forest (MoEF) has notified with reference of The Environment

(Protection) Act, 1986 (29 of 1986) (hereafter in this notification referred to as the Environment Act) read with sub-rule (3) of rule 5 of the Environment

(Protection) Rules, 1986, an area to an extent varying from 294 metres to 16.32



kilometres around the boundary of Deepar Beel Wildlife Sanctuary, in Kamrup (Metropolitan) District in the State of Assam as the Eco-sensitive Zone.

The wetland of Deepar Beel constitutes a unique habitat for aquatic flora and avian fauna. About 150 species of birds have been recorded in the Sanctuary, out of that two critically endangered, one endangered, five vulnerable and four near threatened species are found in the Beel. Elephants regularly visit the wetland from adjoining Rani and Garhbhanda Reserved Forest and the wetland is integral part of the elephant habitat. Besides these, 12 species of reptiles, 50 species of fishes, 6 species of amphibian along with 155 species of aquatic macro-biota, etc. have been recorded in the Sanctuary.

The lake is spread over an area of 10 sq.km within planning area having a complex structure - consisting of water, wetland/marsh and mudflats. The vegetation ranges from small herbs to trees, which supports migratory as well as native birds during summer and winter.

It becomes of utmost importance to preserve a waterbody of this much importance. In order to protect and conserve it, it is proposed to provide a buffer of 50 m around the Deepor beel lake under GMP-2045. Apart from acting as a buffer zone, this area will be developed as a major recreational area for as well as surrounding regions. The water in Oussudu lake comes from the following sources: (i) the run-off from the lake basin and direct interception by the water body; (ii) the water which is diverted through the Basistha river and Mora Bharalu channel to the lake. Therefore, it is important to conserve even the water channels, which brings water to the lake.

A large waterbody like Deepor beel attracting a large number of migrating birds from various corners of the world is itself an asset. However, this requires very careful management to see that it remains a place attractive to the migratory birds. The major problems which is faced by lakes of these kind is pollution arising out of various anthropogenic activities like free flow of untreated sewage to the waterbody, flowing of hydrocarbon elements along with the rainwater in the lake or untreated effluent flowing into the waterbody. It is the general experience that development close to the lake borders with impervious cover invariably increases the phosphate content in the lake. Therefore, the following actions will be necessary to be taken by the local self-government. Similarly, ensuring that no untreated industrial effluent/waste water reaches the lake.

- A regular system of monitoring the quality of water at the points where the storm water channel meet the lake.
- Regular census of birds and in case the coming of any particular species is going down, to enquire to the possible causes.
- To obtain the opinion of ornithologist about the status of planktons in the lake to keep a watch of algae bloom or hyacinth coverage of the water body.
- To collect the record of past incidences of death of fish with probable causes for such incident.
- The idea would be to see whether development of any kind is having any direct impact of the water quality and quantity of the feedstock for the migratory birds.
- Maintenance to see quality and safety of the areas where nests are built or where the eggs are laid.

Moreover, Comprehensive Management Action Plan for conservation of Deepor beel sanctuary needs to be prepared. It is important to note that PCB, Assam has already prepared an Action Plan.

#### **10.9.1.2      *Silsako Beel***

Another notified important waterbody in the planning area is Silsako Lake, which is situated in GMC area and is the second largest wetland in Guwahati region. At present, the site of Silsako is under redevelopment by GMDA for preservation and development as a lake in public domain. Recreational activities are proposed in this area. Moreover, it is important to preserve the water channels, drains, which bring water to this lake as the disturbance of that will lead to water logging in certain areas and sufficient water will not reach to the lake. Thus, the primary drains bringing water to the lake are given the buffer area of 50 m as a regulated development zone.

#### **10.9.1.3      *Borsola & Sarusola Beel***

Borsola and Sarusola beels also notified wetlands under Guwahati Water bodies (Preservation and Conservation) Bill, 2008 which falls under GMC core city area. The major problems which is faced by lakes of these kind is pollution arising out of various anthropogenic activities like free flow of untreated sewage to the waterbody, flowing of hydrocarbon elements along with the rainwater in the lake or untreated effluent flowing into the waterbody. These beels could be redeveloped and could be a place for recreation for core city neighbourhood.

### **10.9.2 Protection of Water Channels**

Protection/conservation of water channels is as much important as preserving a lake as these are the main channels, which brings water to the waterbody. Every stream, tributary, or river has an associated watershed, and small watersheds aggregate together to become larger watersheds. Stream systems have been classified according to their relative position within a stream network in order to understand, discuss, and explore similarities and differences between them. Many stream order classification systems have been developed, but no single system has been universally accepted. One of the earliest methods developed, and arguably the most commonly used method today, was developed by Strahler in 1952. In this system, the smallest head-water tributaries are called first-order streams. Where two first-order streams meet, a second-order stream is created; where two second-order streams meet, a third-order stream is created; and so on.

The major/important water channels with their orders are identified and the identified primary, secondary and tertiary water channels are given a buffer. The buffer zone for water bodies are categorized according to proposed planning strategy. The detail of the buffers are given in the proposed strategy.

In this buffer zone, regulated development is allowed. Protecting the drains will ultimately provide a smooth drainage in the area reducing the risk of flooding and water logging, ensuring uninterrupted flow of water to the waterbody. Other than this, detailed Environmental Management Plan has to be prepared which extensively studies the environmental parameters of the region. Under which numerous proposals can be developed. One of them can be identification of various catchments where the ground water recharge can take place. A concept of green infrastructure can also be adopted. At the site scale, different green infrastructure proposals consisting of site-specific management practices (such as interconnected natural areas) that are designed to maintain natural hydrologic functions by absorbing and infiltrating precipitation where it falls can be introduced.



### 10.9.3 Summary of Environmental Strategies

- The south bank of Brahmaputra River which falls under Master Plan area should be protected as special area upto 50 mt for Public realm and recreational spaces.
- The north bank and south bank of Basistha River falls under GMPA should be protected from urban settlement and need to be utilized as recreational spaces.
- The water bodies (ponds/Lakes) outside the conurbation area should follow the 30m buffer from the edge of the water body boundary.
- The Mora Bharalu River stretch which fall under the GMPA should have the 15 m buffer on both the sides.
- The canals and rivers which fall under the GMPA should have the 15 m on both the sides.
- Guwahati is facing major problem in terms of water supply. There is scarcity of availability of fresh water. To mitigate this issue, it is mandatory to store the fresh water i.e. rainwater. The rainwater harvesting provisions are given in the building bye- laws.
- There is a lack of green spaces/recreational area in the planning area. Thus, after the detail study the city level and neighborhood level parks/playgrounds are proposed.
- Tea Gardens are the traditional farming activity observed in the Planning Area, hence this area will be preserved by declaring agricultural zone under Master Plan -2045 and Regulated Development will be allowed in certain parts of this area.

### 10.8.4 Recreational activities around river

- River Front Development
- Jogging trails around the Water Body
- Water sports activities

#### ***River Front Development***

- Design, development adjacent to natural features in a sensitive manner to highlight and complement the natural environment in areas designated for development;

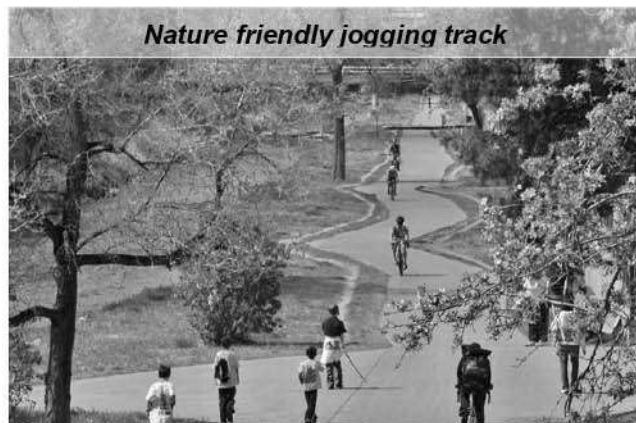


**Suitable River Front Model**

- Integrate development on river fronts with the natural environment to preserve and enhance views, and protect areas of natural drainage;
- Minimize grading to maintain the natural topography, while contouring any landform alterations to blend into the natural terrain;
- Screen development adjacent to natural features as appropriate so that development does not appear visually intrusive, or interfere with the experience within the open space system. The provision of enhanced landscaping adjacent to natural features could be used to soften the appearance of or buffer development from the natural features;
- Use building and landscape materials that blend with and do not create visual or other conflicts with the natural environment;
- Design and site buildings to permit visual and physical access to the natural features from the public right-of-way.

### ***Jogging trails around waterbody***

Jogging trails are popular for bird viewing, walking, bike riding and other outdoor activities. Land managers often design and maintain trails in expansive public use areas. There is increasing interest from homeowners, business owners, wildlife enterprise entrepreneurs, schoolteachers, boy



scouts, hospital personnel, parks department staff and others to develop and maintain nature trails on smaller landholdings.

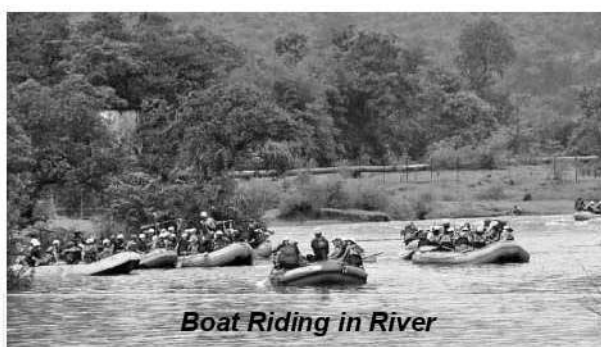
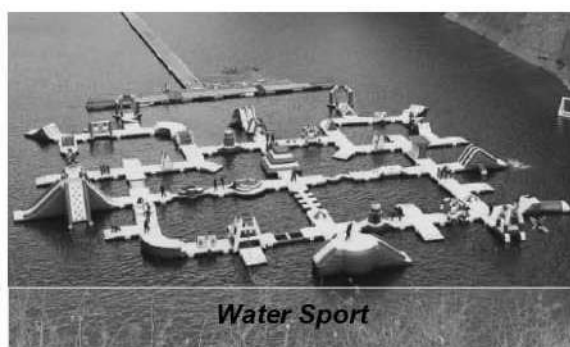
Nature trails can be designed to minimize human disturbance and impacts on wildlife, plants, soils, and waterways. A well-designed trail can aid in land management, such as through simplifying timber evaluations or creating fire breaks. Properly built trails also provide opportunities to teach youngsters about wildlife, forestry, and natural resources.

To reduce impacts of trails and trail users on wildlife and plants, best trail practices are:

- Align trails along or near existing human-created edges or natural edges rather than bisecting undisturbed areas.
- Keep a trail and its zone of influence away from specific areas of known sensitive species.
- Avoid or limit access to critical habitat patches.
- Provide diverse trail experiences so that trail users are less inclined to create trails of their own.
- Use spur trails or dead-end trails to provide access to sensitive areas because these trails have less volume.
- Generally, concentrate activity along trails rather than disperse it.
- Keep trail construction impact as narrow as possible.
- Concentrate weed control at road and trail crossings, trailheads, and riparian areas

### ***Water Sport Activities***

Water Sport Complex could be identified on suitable river frontage area where water Sport activities like boating, Jet ski, riding could be promoted for public recreational activities.



## **11. DISASTER MANAGEMENT**

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### **11.1 Introduction**

Disaster is an undesired calamitous event that seriously disrupts the functioning of a community or society and causes human, material, and economic or environmental losses that exceed the community's or society's ability to cope using its own resources. Disasters are usually caused by nature but in some cases, it can be caused by human actions as well. Disaster can be broadly classified into Water and Climate related, Geology related, and Accident related. India has been traditionally vulnerable to natural disasters on account of its unique geoclimatic conditions. Floods, droughts, cyclones, earthquakes, and landslides have been recurrent phenomena. About 60% of the landmass is prone to earthquakes of various intensities; over 40 million hectares is prone to floods; about 8% of the total area is prone to cyclones and 68% of the area is susceptible to drought.

At the national level, the Ministry of Home Affairs is the nodal Ministry for all matters concerning disaster management. The Central Relief Commissioner (CRC) in the Ministry of Home Affairs is the nodal officer to coordinate relief operations for natural disasters. The CRC receives information relating to forecasting/warning of a natural calamity from India Meteorological Department (IMD) or from Central Water Commission of Ministry of Water Resources on a continuing basis. The Ministries/Departments/Organizations concerned with the primary and secondary functions relating to the management of disasters include India Meteorological Department, Central Water Commission, Ministry of Home Affairs, Ministry of Defense, Ministry of Finance, Ministry of Rural Development, Ministry of Urban Development, Department of Communications, Ministry of Health, Ministry of Water Resources, Ministry of Petroleum, Department of Agriculture & Cooperation, Ministry of Power, Department of Civil Supplies, Ministry of Railways, Ministry of Information and Broadcasting, Planning Commission, Cabinet Secretariat, Department of Surface Transport, Ministry of Social Justice, Department of Women and Child Development, Ministry of Environment and Forest, Department of Food.

Guwahati is situated at 26° 10' north latitude and 92° 49' east longitude. Located on the banks of the Brahmaputra River, it is the largest commercial, industrial and educational centre of the N-E region. The city is located towards the South-eastern

side of Kamrup district, surrounded by Nalbari district in the North, Darrang and Morigaon districts in the East, Meghalaya State in the south and Goalpara and Barpeta districts in the West. The city is situated on an undulating plain with varying altitudes of 49.5 m to 55.5 m above Mean Sea Level (MSL). The Southern and Eastern sides of the city are surrounded by hillocks. Apart from the hilly tracts, swamps, marshes, water bodies like Deepor Beel, Silpukhuri, Dighali Pukhuri, Borsola Beel and Silsako Beel etc. also cover the city<sup>15</sup>.

The total population of Guwahati Metropolitan Planning Area is 11,41,699. As per the data released by Govt. of India for Census 2011, Guwahati is an Urban Agglomeration coming under the category of Class I UAs/ Towns. The city is governed by Municipal Corporation and is situated in Guwahati Urban Region<sup>16</sup>.

According to the Assam State Disaster Management Policy (2010), landslides and urban floods are the two most prevalent hazards that undermine the urban development of Guwahati, though other disasters like Earthquake, Thunderstorms also happens but the impact of flood and landslide is huge and requires serious and constant attention. Several landslides have occurred in Guwahati in recent years, causing extensive damage to life and property and have adversely impacted economic development. Continuous rainfall during monsoon aggravates the situation by causing more soil erosion associated with siltation. The poor and socio-economically weaker sections living in marginal and fragile areas are the most affected and vulnerable communities. Apart from these location in high seismic zone also makes Guwahati quite vulnerable.

The basic objective of current Disaster Management Action Plan is to protect all the residents and the wealth of the region from all sort of untoward incidents through the following objectives.

- To mitigate impact of natural and man-made hazards through preparedness at District and Ward level.
- To provide effective support and resources to all the concerned individuals, groups and departments in disaster.
- To assist the line departments, communities in developing compatible skills for disaster preparedness and management.

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<sup>15</sup> [http://jnurm.nic.in/wp-content/uploads/2010/12/CDP\\_Guwahati.pdf](http://jnurm.nic.in/wp-content/uploads/2010/12/CDP_Guwahati.pdf)

<sup>16</sup> <http://www.census2011.co.in/census/metropolitan/177-guwahati.html>

- To disseminate factual information in a timely, accurate and tactful manner while maintaining necessary confidentiality.
- To develop immediate and long-term support plans for vulnerable people in/during disasters.
- To create awareness among the people about hazards occurrence and increasing their participation in preparedness, prevention, development, relief, rehabilitation and reconstruction process.
- To have response system in place to face any eventuality.
- To affect or elicit the least possible disruption to the normal life process when dealing with individuals in disaster.
- To ensure active participation by the Government Administration, communities, NGOs, CBOs, and volunteers at all levels making optimal utilization of human and material resources during the time of disaster<sup>17</sup>.

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<sup>17</sup> District Disaster Management Plan, Kamrup Metropolitan District



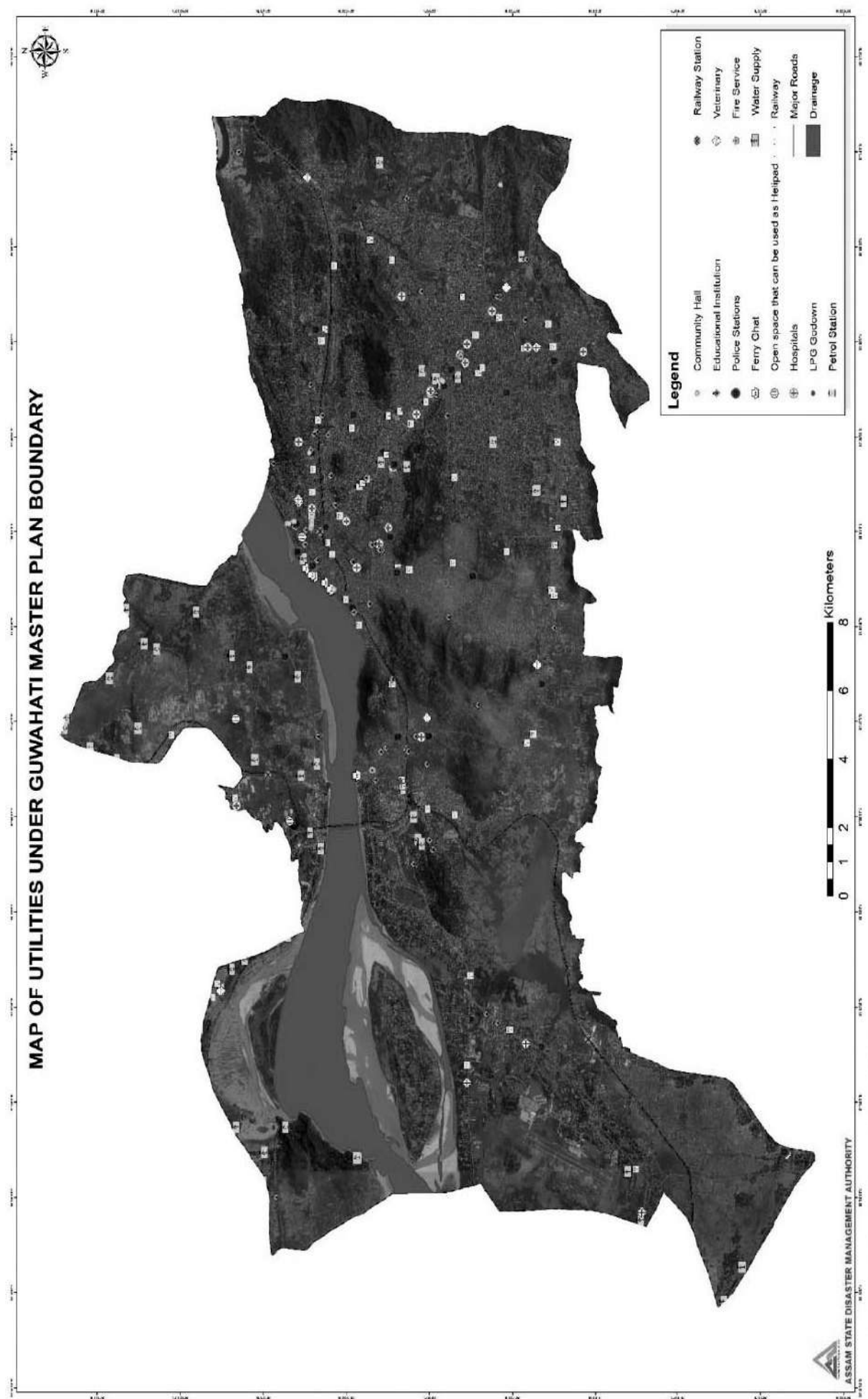


Figure 11-1: Available Utilities within GMPA

## 11.2 Risk and Vulnerability Assessment of Guwahati City

### 11.2.1 Types of Vulnerability

**Physical vulnerability:** It relates to the physical location of people and elements at risk buildings, infrastructures etc and their proximity to the hazard.

**Socio-economic Vulnerability:** This relates to the degree to which a population is affected by the calamity in relation to the prevailing social and economic conditions. The impact of a disaster is determined by the event, its effects on people and their environment, as well as the consequential effect on human activities within a given society.

**Capacity:** Capacity is the resources of individuals, households and communities to cope with a threat or resist the impact of a hazard.

**Risk:** Risk is a measure of the expected losses due to a hazard/ event of magnitude occurring in a given area over a specific time period. Risk is a function of the probability of occurrences and the losses each would cause.<sup>18</sup>

Unplanned, unregulated urbanization and its consequences, past climate variability and associated impacts, disasters including floods, earthquakes and landslides are the main Three components to hazards in the city<sup>19</sup>.

### 11.2.2 Unplanned /unregulated urbanization

Urban growth in the city of Guwahati has been rapid, unplanned and organic. Rapid population growth, high migration rates and change in land use pattern of the city due to uncontrolled development activities is said to have done a lot of harm to the ecology and environment of the city. Illegal construction on hills has been one of the major causes for landslides. Uncontrolled urban development, particularly construction activities in and around the city is a major threat to this city on high seismic activity zone.

#### 11.2.2.1 Population growth

Guwahati city has experienced considerable population growth in the past few decades although the decadal growth rate seems to have a declining trend over the years. The population of Guwahati Municipal Corporation area including the out growth

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<sup>18</sup> District Disaster Management Plan, Kamrup Metropolitan District

<sup>19</sup> Climate Proofing Guwahati, Assam: City resilience strategy & Mainstreaming Plan, Teri, 2013

area has seen a decadal growth of 18.29% from 8, 18,809 in 2001 to 9, 68, 549 in 2011. 10% of the population in 2011 falls in the age group of 0 to 6 as compared to the national average of 13.12% and the state average of 14.47%. Also, there is large floating population ranging to about 1.5-2 lacs in a week which also leads to load on infrastructure (Consultation with JICA). Besides the main population residing in the city, 10% is floating population which comes for daytime activities (Master Plan, 2025).

#### **11.2.2.2 Migration**

Migration has been a continuous phenomenon for Guwahati city in the past few decades. Economic opportunities along with many social and political reasons govern migration of people to the city. Better urban services as compared to other rural areas such as education and medical facilities also are factors affecting immigration. In the past few years, with a rapid increase in employment opportunities due to growth of industries and other secondary & tertiary sectors, migration has taken place from different cities and villages. As in most cases these people are poor or from economically backward background and thus they tend to settle in illegal settlements and encroachments on hills or fragile lands. The recent increase in slum areas is an indication of increased migration in Guwahati (CDP, Guwahati).

### **11.2.3 Climate trends**

#### **11.2.3.1 Temperature**

The climate of Guwahati does not differ from that of the other districts of Assam. Guwahati has a humid subtropical climate. The average annual temperature is 22.2°C, with extremes ranging from 39.5 C recorded on 24 April 2014 to 2.0 C recorded in January 1964. In March and April, the weather begins to grow a little warmer. During the height of the rains, the climate is decidedly oppressive.

Climatically from February to May, the weather is dry and moisture less and the heat is gentle; from June to October, there is enough rain and moisture, and the heat is very unbearable and from November to January, the climate is cold and foggy. During the latter part of December and early part of January, the Brahmaputra fog can be very cold while in March, the wild wind carrying the Brahmaputra sand can be seen everywhere.

From the end of February, the mercury level gradually goes up and in July, August and September the temperature reaches the maximum point. During these months,

the mean maximum temperature does not generally come down below 31°C and even sometimes it goes to above 40°C. These months are treated as hottest months for the district in each year.

Table 11-1: Month wise Min and Max Temperature

Month	Min	Max.	Month	Min.	Max.
January	8.5	21.6	July	25.3	31.7
February	10.9	25.1	August	25.4	28.8
March	15.5	38.1	September	24.4	31.4
April	19.9	25.3	October	19.9	30.2
May	22.4	26.7	November	14.8	36.5
June	24.8	28.4	December	9.8	23.4

(Source: India Meteorological Department)

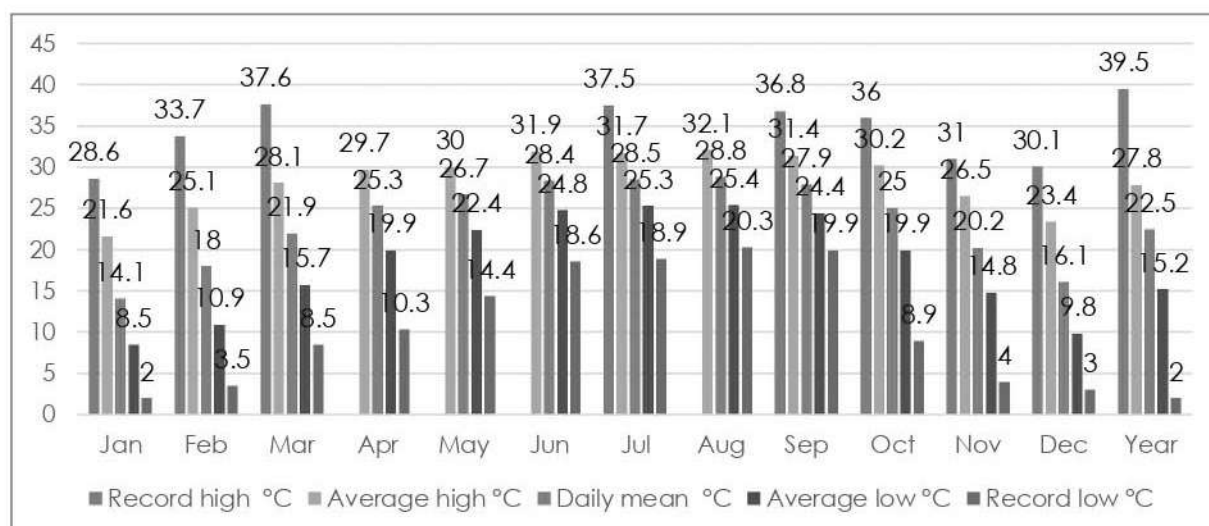


Figure 11-2: Monthly min and max temperature

### 11.2.3.2 Rain Fall

The annual rainfall in the Guwahati is 1751.8 mm with average relative humidity of 72%. Rainfall records shows a decreasing trend towards east and west of Guwahati city. The average rainfall is 146 mm. The months of March, April and May constitute the pre-monsoon season. The norwesters locally called Bordoichilla appears during that period. Rainfall ranges between 58 mm and 243 mm. With the onset of monsoon in early June, heavy rainfall occurs. Widespread low clouds and high humidity together maintain almost uniform temperature over the area. The average annual rainfall during the period is 326 mm. The occurrence of thunderstorms is the most conspicuous characteristics of the monsoon weather. This is the season of dominant agricultural operation. The monsoon withdraws from the area in the last week of September or

first week of October. The cool north-easterly winds originating over the lofty mountains of the Meghalaya brings the temperature down. The orographic low is replaced by high pressure and a flat pressure gradient occurs. Rainfall decreases abruptly and the sky becomes progressively clear. Sunny days prevail till the end of November. Month wise normal maximum and minimum temperature is given in Table 11-2.

Table 11-2: Monthly average rainfall, rainy days and relative humidity in Guwahati

Year	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Annual
<b>Rain Fall mm (inches)</b>	12.0 (0.47)	22.3 (0.88)	58.4 (2.30)	187.8 (7.39)	243.1 (9.57)	295.0 (11.61)	326.2 (12.84)	265.7 (10.46)	197.8 (7.79)	121.3 (4.78)	16.0 (0.63)	6.2 (0.24)	1,751.8 (68.97)
<b>Av. rainy days</b>	1.2	2.3	4.7	10.3	13.3	14.7	16.1	12.9	9.7	5.0	1.0	0.6	91.9
<b>Av. relative humidity (%)</b>	70	56	50	62	70	77	80	80	81	79	77	76	72

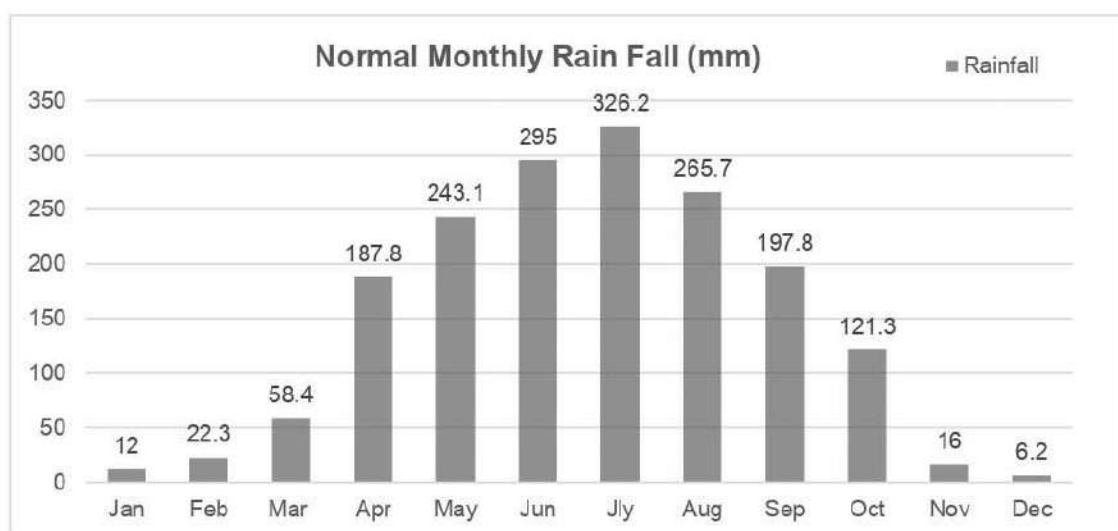


Figure 11-3: Normal monthly rainfall in Guwahati

## **11.2.4 Main findings from the Vulnerability assessment**

### **11.2.4.1 *Current Risks profile***

The three components of hazards as identified have multiple impacts on the urban systems. The degree of risk to the city due to climate change related variables would be directly proportional to the current situation of the urban systems like services, infrastructure, housing and land use planning. This chapter assesses the current situation and thus the coping capacity of the key sectors that would be directly or indirectly impacted due to climate change. The chapter further provides a detailed future climate projection analysis and builds a case for a resilience strategy for the city of Guwahati. As per the risk analysis and hazard assessment exercise, during the process of the study the following sectors have been identified as the key sectors that need to be studied to understand the present and future vulnerability of the city in the context of climate change impacts. After discussions with the city officials, sector wise gaps and problems were identified.

- Urban planning
- Ecosystems and land-use
- Urban infrastructure and services
- Informal settlements and slums
- Poverty and livelihood
- Emergency response capacity

#### ***Urban Planning***

According to city consultations, restricting construction and densification is difficult because the FSI (Floor Space Index) is already higher in Guwahati than some other cities. Also, the present infrastructure is not sufficient to support re- densification. Hence the GMDA is thinking of developing satellite towns which act as counter magnets to the Guwahati city. The Master Plan talks about 3 new towns to be developed for this purpose. The satellite towns so developed need to have such activities which attract population to live and work there. However, this also means that transport planning has to be an integral part of this exercise to ensure better commuting possibilities (for example, introducing monorail) between the satellite towns and GMR. Re-densification could then be attempted along these transport routes. GMDA is planning to expand the metropolitan area and identify satellite townships for not only residential complexes but also for commercial activities to reduce the commuting pressure on the existing transport system. The major



observations outlining the gaps for the urban planning sector have been listed in following table

*Table 11-3: Gaps and issues in the urban planning sector*

Issue	Description
Urban congestion & illegal constructions	Illegal settlements by low-income groups on hills are more prone to landslides and add to the vulnerability of the city. Guwahati also faces problems of weak constructions and poorly built housing due to lack of efficient enforcement of building codes laid down by Guwahati Municipal Corporation and Guwahati Metropolitan Development Authority
Expansion in land use pattern (especially on hills)	Illegal settlements by low-income groups on hills are more prone to landslides and add to the vulnerability of the city. Moreover, the people living there are mainly living in temporary structures which are more fragile. Unauthorized cutting of hills has led to silting in the downstream areas.

### ***Ecosystem and Land use***

Guwahati city is located in a valley surrounded by hills on three sides. It has large area under hillocks and water bodies. However, rapid unplanned urbanization has led to major changes in the land use pattern resulting in major repercussions on the natural landforms as well as on the entire ecosystem of the city. The major observations outlining the gaps for the ecosystem and land use sector have been listed in following table.

*Table 11-4: Gaps and issues in the ecosystem and land use sector*

Issue	Description
Change in topography (due to external factors)	External factors such as development near Meghalaya border have also led to change in the topography. There are flash floods near agricultural university area. A lot of industries, schools, colleges etc. have been built along the border which not only threat the environment of the city (cutting of hills is a major problem) by aggravating and causing floods, siltation, air pollution; but are also putting pressures on the infrastructure and services of the city as this development is depending on Guwahati city for its requirement
Deforestation & construction on hills	Uncontrolled deforestation and construction on the hills in Guwahati has resulted in more exposed slopes which are more prone to soil erosion as compared to the vegetation covered

	<p>slopes. Increased soil erosion not only results in loss of soil fertility but also causes problems of water logging and flash flood down the slope. There is a need of regulating cutting of trees and encroachment in forest areas (Master Plan of Guwahati city 2025). During consultation exercise with GMDA, it was revealed that the Master Plan of Guwahati clearly demarcates the eco-sensitive zones where development should be restricted. Still, the hill areas and hillocks are being encroached upon.</p>
Hill encroachments	<p>The area covered by hills is owned by the state government (around 70%) and the rest is forest area (~20%) or owned by genuine land owners (10%). Thus, the area falls under the jurisdiction of District administration and the urban local bodies of Guwahati can't take any regulatory actions against it. A high level committee has been established within GDD to recommend solutions on the illegal encroachment of these hill areas</p>
Waste discharge in rivers	<p>The area covered by hills is owned by the state government (around 70%) and the rest is forest area (~20%) or owned by genuine landowners (10%). Thus, the area falls under the jurisdiction of District administration and the urban local bodies of Guwahati can't take any regulatory actions against it. A high level committee has been established within GDD to recommend solutions on the illegal encroachment of these hill areas</p>
Destruction of Wetlands	<p>The expanse of Deepar Bil, which is an important water body in Assam has also been reduced drastically by 14.1% between 1990-2002. Illegal construction in the buffer zones, dumping of garbage, encroachment of the lakebed, brick kiln and soil quarrying in the lakebed are the direct threats on the wetland (Carrying Capacity Based Urban Development Regulations, Guwahati, 2011).</p>

To understand the vulnerability of the natural environment in Guwahati city, a trend analysis was carried out for the last decade (1999-2010) using satellite imagery.

### ***Vegetation health***

Normalized difference vegetation Index (NDVI) has been used as an indicator of vegetation health<sup>20</sup>. NDVI is captured using the information gathered by the satellite

<sup>20</sup> The Normalised Difference Vegetation Index (NDVI) map zoomed in the Guwahati area. This index uses the NIR and Red bands. This index enhances the vegetation of an area. The healthier vegetation

sensors in near-infrared and red wavelength. Being normalized in nature, it is able to capture the variation in the vegetation vigor and the health. The temporal vegetation index maps reveal that the extent of vegetation cover (i.e., forest) has decreased over the period all over the city area. The vigor (vegetation health) has also degraded over the study period. The remnants of healthy vegetation have remained in the southern part of the Guwahati township.

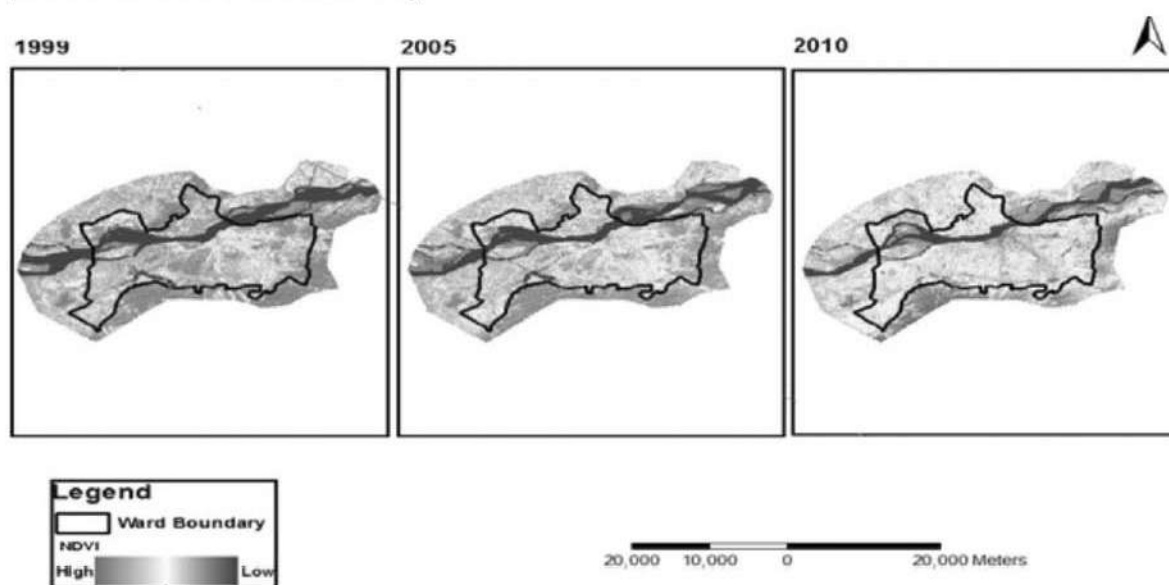


Figure 11-4: Normalized Vegetation Index<sup>21</sup>

### **Bareness**

Surface Bareness has been computed through the normalized bareness Index<sup>7</sup> using the information gathered by the satellite sensors in mid-infrared and thermal wavelength. It indicates the cumulative effect of vegetation content covering the land, moisture content present over the land surface and impervious surfaces/urban fabrics. The temporal maps indicate increase in bareness over the surface in Guwahati city. This is due to decrease in vegetation cover, decrease in capability of holding moisture or water and dryness over the land surface.

will show a higher value than others. It is given by:  $(pNIR - pR) / (pNIR + pR)$ . As can be seen from the figure from 1999 to 2010 vegetation decrease as the blue color increases. Blue color represents poor quality vegetation

<sup>21</sup> Climate Proofing Guwahati, Assam: City resilience strategy & Mainstreaming Plan, Teri, 2013

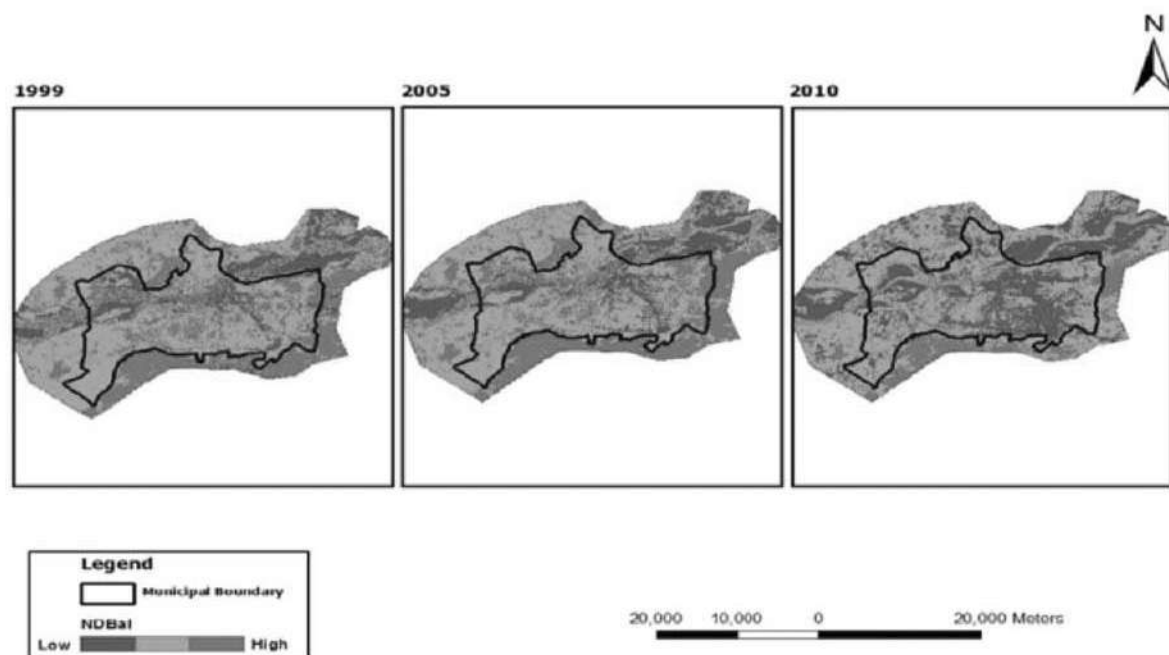


Figure 11-5: Normalised Bareness Index<sup>22</sup>

### Urban Infrastructure and Services

Infrastructure and services are the backbone of the city and play an important part not only in ascertaining the quality of life of its citizens but also in attracting investments thus bringing in prosperity for the city. Poor or sub-standard infrastructure services increase the vulnerability of the population to manifolds in case of disasters and climate related extreme events. Variability in climate due to climate change impacts would also have impact on infrastructure, particularly basic service provision like water and sanitation, drainage and sewerage and solid waste management.

### Water Supply

- 35% of the city is covered by piped water supply. (Master Plan 2025) The potable water generation capacity in Guwahati is 98 MLD; however, water produced is only 78 MLD as against the current demand for 132 MLD.
- The projected demand for the city by the year 2025 is estimated to be 425 MLD. As per the GMDA figures, 63.5% of the needed water is extracted from ground in the form of hand pumps, tube wells and wells in GMA (Carrying Capacity Based Urban Development Regulations, Guwahati, 2011).
- The major industries including the IOC's Oil refinery, The Railways, Airport and Defense establishment at Guwahati collect treat and supply water for their own requirement on their own, River Brahmaputra being their major source. The Master Plan proposes that all the industries in future would have to manage the

<sup>22</sup> Climate Proofing Guwahati, Assam: City resilience strategy & Mainstreaming Plan, Teri, 2013

water collection treatment and supply on their own without any help with the Municipal Corporation.

- Only one water supply project worth Rs. 280 crores (90% funding from Centre) was sanctioned for financial support under JnNURM under water supply sector. This project covered the West Guwahati region. Besides this the South-Central, Guwahati and North Guwahati are to be covered by water supply schemes by JICA finding. The major observations outlining the gaps for the water sector have been listed in the table 11-5.

Table 11-5: Gaps and issues in the water supply sector<sup>23</sup>

Issue	Description
Gaps in water supply network	<p>The water supply network of GMC covers about 20% of the municipal area. This system was developed in the 1950s and is facing a lot structural, pressure and quality issues due to wear and tear and lack of maintenance. The supply is also intermittent. The Master Plan informs that the yield of the shallow tube wells is not significant, and that possibility of ground water extraction is remote due to the hard rock surface of the city. Thus, the river Brahmaputra is the main source of water for the city. The water supply duration is as slow as 3 hours during a day.</p> <p>The system of AUWS&amp;SB covers about 5-10% of the city. It is relatively new system and is metered. However, the supply is intermittent, and the meters do not work as the pressure is very low. The rest of the city is using water either extracted through private bore wells or from the municipal tankers</p>
Inefficiency in water supply	<p>The city development plan (CDP) informs that the water treatment plants are running below their capacities, currently at an average of 50% their capacity. The transmission losses are estimated to be as high as 40%. There is a grave need to augment present capacity, maintain and refurbish the old treatment plants particularly the Panbazar treatment plant which has expired its design life. The CDP notes that the city is not able to update its efficiency, to be able to supply as per the stipulated norms of 150 LPCD (MoUD SSLBs) and a 24X7 supply, and thus needs to build new capacity considering the huge increase in estimated demand for water in near future. The CDP also identifies inadequate human resource development and training</p>

<sup>23</sup> Climate Proofing Guwahati, Assam: City resilience strategy & Mainstreaming Plan, Teri, 2013

	in modern utility operations as one of the gaps that leads to inefficient water supply situation in the city.
Water quality	The water quality of the river Brahmaputra has low organic pollution and mineral contents are optimum. However, the water quality is poor along its flow within the city. Also in the absence of a sewage system at place in the city, the municipal waste and waste from the oil refinery is discharged directly into the river leading to high turbidity, faecal contamination. The rivers like Bharalu and Deepor Bil (RAMSAR site) are under the threat of degradation due to this. The ground water sources are also said to be unsuitable for drinking. It is found that the ground water is inflicted by high fluoride and arsenic content.
Water tariffs	The water charges that are levied and billing/collection mechanisms are inadequate and hence the revenues required for repair, maintenance and replacing of infrastructure are not recovered fully. Water tariffs are being charged based on the property assessments of 1971 and have not been revised since then.

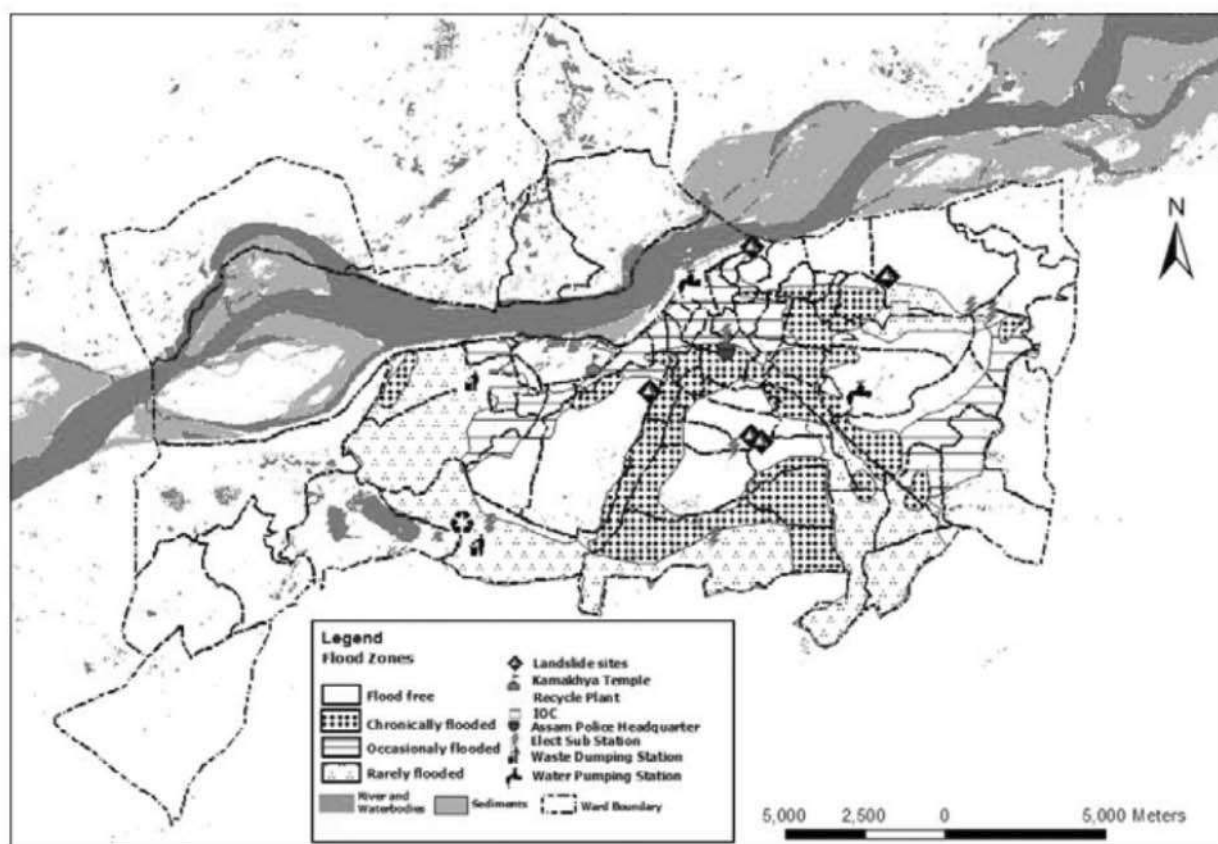


Figure 11-6: Vulnerability of urban services and infrastructure



***Guwahati Water Supply Project***

In order to have a modernized, 24x7 and metered water supply system with progressive pricing covering the whole Kamrup Metropolitan Area (KMA, beyond GMC limits); the Guwahati Development Department has initiated the Guwahati Water Supply Project. KMA has been divided into 4 zones and water supply system is developed in these through 3 different schemes funded under JnNURM (30%), with assistance from JICA (60%) and ADB (10%). The nodal agency for implementation is GMDA. The present 3 systems will become defunct once this comes into operation. The perspective year for the water supply project is 2040 with a review planned by 2025. The planned capacity will be developed @ 135lpcd. Also, there would volumetrically tariff structure with progressive pricing. A 'Jal Board' is being constituted from GMC, PHED and AUWS&SB, which will be the nodal agency for maintenance, operation, distribution, and revenue collection.

***Sewerage***

The Master Plan stipulates setting up of a sewerage system in the towns, including a system for the proposed new towns as an extension to the Guwahati city limits. The CDP highlights that unplanned urban development has led to the formation of stagnant pools of wastewater that cause spread of diseases. The plan calls for development of sewerage and drainage system including waste treatment facility. The system becomes very crucial as an infrastructure requirement because frequent flooding and water logging of the city due to floods. The Master Plans estimates a generation of 225 MLD of wastewater from Guwahati city and 107.2 MLD for proposed new towns. The CDP, which is an older document, calls for requirement of Rs 300.98 Crores for an integrated sewerage and sanitation system with additional allocation requirement of Rs 5 Crores for creating awareness. The CDP suggests a three phased approach where it proposes sewerage collection system to be developed in short term (1-3 years), augmenting sewerage coverage as a medium term measure (2-5 years) and development of tertiary treatment and recycling facilities as a long term measure (5-10 years). The major observations outlining the gaps for the sewerage sector have been listed below.

Table 11-6: Gaps and issues in the sewerage sector<sup>24</sup>

Issue	Description
Lack of sewerage system	The city does not have a sewerage system at place. The city is dependent on the septic tank system the effluent is released untreated into the nearby drains and low-lying areas. The industrial waste water is also being released in the river and its tributaries untreated. The undulating and bowl shaped topography makes it all the more important to have proper drainage, sewerage and storm water system at place to avoid accumulation of water and associated hazards. The subsoil water table is very high in many areas in the city, leading to non-functional soak pits.

### **Drainage**

Since urban flooding has emerged as one of the main risks, addressing drainage both natural and man-made helps in reduction of climate related vulnerability in the city. Current status Except for the 17km drains built by the Town and Country Planning Organization in 1970s, no other planned drainage system exists within the Guwahati Metropolitan area. The Master plan 2025 gives a detailed account of the condition of the drainage system in the city and puts forward the need for design of a scientifically correct and feasible proposal for storm water and drainage system in the city. A separate proposal has been made under the JNNURM scheme which is completely disjointed to what the Master Plan suggests. The JNNURM scheme while giving separate plans for each basin, gives a plan that includes rehabilitation of existing drainage system along with new drains, culverts, pumping stations and sluice gates. According to the Detailed Project Report on storm water drainage (2008), the total capital cost of all items proposed under the project is Rs. 7.5 billion. The major observations outlining the gaps for the drainage sector have been listed in table 11-6.

### **Characteristics of the Natural Drainage Basins**

The city of Guwahati is located along the bank of river Brahmaputra with the river at the North and a series of hills all along the remaining periphery except in the west where the Deepor beel is located, one of the RAMSAR Site- Important ecological areas. The shape of the city inside these natural boundaries is a bowl with number of hills and wetlands known as 'beels' in the local language. Two rivulets; Bharalu and

<sup>24</sup> Climate Proofing Guwahati, Assam: City resilience strategy & Mainstreaming Plan, Teri, 2013

Basistha originating from the Southern hills of Meghalaya are the natural drainage channels for the Guwahati Metropolitan Area. The Bharalu river falls into the river Brahmaputra, while the Basistha falls into the Deeper Beel. Deepar beel is connected to the river Brahmaputra through a stream known as Khona Jan. In Guwahati the number of rainy days ranges from 90 to 120 days. Almost 80% of the rain occurs in the two monsoon months leading to water logging and flash floods in the city. The rising of ground water table during monsoon season, when the river Brahmaputra is rising saturates the entire area under plains and reduces percolation of excess water into ground. The rains on the hills that make the boundary of the city, including the KJ hills in Meghalaya and the isolated hilly areas in the east become the major cause of considerable amount of storm water entering into the GMA area. Besides this the average ground level of the river Brahmaputra is higher than the rest of the city, hence preventing the gravity flow if storm water of the city into the river. Sluice gates have to be installed at the down steam areas of the Bharalu channel, Bondajan and Khonajan areas to prevent backflow from the river Brahmaputra. The GMA area is divided into 6 natural drainage basins which are all significant for planning and designing the drainage system in the city (Bharalu basin, Deepal basin, Silsako basin, Foreshore basin, North Guwahati basin, Kalmoni basin)<sup>25</sup>.

Table 11-7: Gaps and issues in the drainage sector<sup>26</sup>

Issue	Description
Inadequate capacity of existing drains	The smaller drains built along the roads do not cater to the drainage requirement of the city which is prone to heavy rainfall and flooding. Moreover, the drains have been encroached upon further decreasing their capacity to drain storm water. The silt coming from the hills and inadequate section of the outfall channel contribute to blocking of drains and overflow of water within the city, leading to floods and water logging within the city.
Built up on the natural drainage pattern	A lot of built up has emerged in the low lying areas of the city, blocking the drainage pattern. This is typically the case in the most densely populated areas of the city and poses health problems and loss to property. Many areas of the city remain water logged during monsoon months and effective drainage

<sup>25</sup> Guwahati Master Plan 2025

<sup>26</sup> Climate Proofing Guwahati, Assam: City resilience strategy & Mainstreaming Plan, Teri, 2013

	system is a pre-requisite to ensure a solution. Garbage dumping has resulted into blockages in the natural drainage pattern.
Topographical features	Since most of the drains fall in the upstream side of the river Bharalu, they are rendered ineffective because of the higher level of the river to that of the drains. The river Bharalu is exposed to heavy siltation and a lot of encroachment has come up on the catchment of river Bharalu endangering the entire natural drainage system of the city.
Encroachment of swamps and natural water reservoirs	The original swamps and natural water reservoirs are being filled up for development purposes leading to floods and stagnant water at several places within the city.
Uncontrolled development, deforestation and cutting of hills	Cutting of hills for encroachment, constructing buildings and large scale deforestation in the city has led to blockage of drainage channels, destruction of top soil and high rate of soils erosion on the exposed hill slopes. This not only increases the storm water flow from the hills to the plains within the city but also brings in lot of mud, and suspended material to the grounds.
Lack of robust water drainage schemes	Guwahati Metropolitan Area Storm Water Drainage Scheme and the schemes prepared by the Town and Country Planning Organization have not taken up as they were envisaged. The Master Plan argues that not enough time was provided to make a scientific evaluation of the storm water drainage system requirement in the city. These schemes instead of focusing on major projects to deal with severe flooding have turned out to be piecemeal efforts leading to construction of a few drains alongside the roads.

### ***Solid Waste Management***

As per the CDP, the solid waste management is highly inadequate at present and needs urgent attention in the city. Solid waste management is the responsibility of the Guwahati Municipal Corporation and has been vested to the engineering department. For operational purposes the entire area is divided into 21 zones. Each zone comprising of 3 to 5 wards. Each zone is headed by the Zonal Engineer with inspectors and supervisors to oversee the daily activities. The zonal engineers report to the Divisional Engineers. Each division supervises 4-5 zones. It is projected that the estimated generation of waste kg/per capita /per day in Guwahati by the year 2025

would be 0.8 which is larger than the norms for a class I city. To enable the city to manage such volume of waste and to make the city clean and healthy, there is a strong need for having an integrated solid waste management system at place citywide. The Master Plan predicts that by the year 2025, the city would be generating solid waste in the order of 0.8 kg per capita per day, while the waste generated from hospitals would be of the order of 0.5 kg/capita/day by 2025. Right now there is no separate disposal system for waste from hospitals as per norms. The Master Plan also reveals that 90% of waste generated is organic in nature and the landfill area requirement for the city has been estimated to be 38 hectares for present capacity and is projected to increase to about 91 hectares by 2025. A 24 Hectares solid waste management site is proposed at Paschim Boragaon at Guwahati; presently GMC is dumping collected waste at Belortol near Pamohi River. The major observations outlining the gaps for the solid waste management sector have been listed below.

*Table 11-8: Gaps and issues in the solid waste management sector*

<b>Issue</b>	<b>Description</b>
Segregation and storage of waste is absent	The smaller drains built along the roads do not cater to the drainage requirement of the city which is prone to heavy rainfall and flooding. Moreover, the drains have been encroached upon further decreasing their capacity to drain storm water. The silt coming from the hills and inadequate section of the outfall channel contribute to blocking of drains and overflow of water within the city, leading to floods and water logging within the city.
Door to door collection/ primary collection	A lot of built up has emerged in the low-lying areas of the city, blocking the drainage pattern. This is typically the case in the most densely populated areas of the city and poses health problems and loss to property. Many areas of the city remain waterlogged during monsoon months and effective drainage system is a pre-requisite to ensure a solution. Garbage dumping has resulted into blockages in the natural drainage pattern.
Transportation	Since most of the drains fall in the upstream side of the river Bharalu, they are rendered ineffective because of the higher level of the river to that of the drains. The river Bharalu is exposed to heavy siltation and a lot of encroachment has come up on the catchment of river Bharalu endangering the entire natural drainage system of the city.



Processing and  
Disposal

The original swamps and natural water reservoirs are being filled up for development purposes leading to floods and stagnant water at several places within the city.

### ***Electricity/ Power***

The city frequently faces power disruption, and hence during any extreme events power failure might cause problems. The Master Plans gives recommendations for the improvement in transmission and distribution of power supply, although it does not convey the responsibility to any institution. Guwahati power zone is covered through three electrical circles; however, the Guwahati Metropolitan Area gets its power supply through the Kahili Para substation. The power to this grid substation is fed through 6 power stations namely, Chandrapur Thermal Power Station, MSEB Hydel System, Bongaibaon Thermal Power Supply, Namrup PS, Lokwa PS, Mobile Gas tribune.

At present there is a gap of 48 MVA between the power demand and the availability of power in Guwahati. A proposal to build three more receiving grids of total capacity of 150 MVA tapping power from Assam State Electricity Board and different power plants of the central sector has been proposed under JNNURM. The Master Plan estimates requirement of about 23 substations to cater to power demand by year 2025. However, it does not provide any phased plan which informs of how the present deficit of the power will be curbed and how the future demand s for power will be met.

As is known, during floods the water has to be pumped out of the town and so uninterrupted power is needed during rainy season. The city utilizes diesel run generators for the same at present (as discussed during consultations). It is pertinent to note here that Guwahati is also a solar city under the Jawaharlal Nehru National Solar Mission of the Ministry of New and Renewable Energy. Guwahati is one if the 60 identified cities to be developed as solar cities under the mission.

### ***Transportation System***

The transport system of Guwahati is crucial for the connectivity of the entire north-east region. The transport system plays an important role of promoting the development of the backward regions and integrating them with the mainstream economy by opening them to trade and investment.

According to the Master Plan of Guwahati City, 171.3 km of main road network was studied. The study shows that the road network is still not very efficient as 72% of road length did not have footpaths; 40% of the road length did not have drainage facility



and nearly 70% of the road length did not have street lighting facility. This eventually hinders the drainage of storm water and movement & evacuation at the time of flooding events.

### ***Health Facilities***

Guwahati is highly prone to water logging owing to its topography, climatic conditions and lack of adequate sanitation & drainage infrastructure. As a result, the city faces high risks from diseases caused by contaminated drinking water and vectors.

With respect to the health care set-up in the city, at present there are 4 Government hospitals (including the CRPF Hospital) which house about 2430 beds. Apart from this there are 23 non-government/ private hospitals (with 1724 beds) and 24 non-government/ private nursing homes (with 696 beds). Moreover, there are 8 other government run hospitals/ medical units, 20 Urban Health Centres (UHCs, established under the NRHM) and numerous PHCs (Primary Health care Centres). As a result, availability of health care infrastructure in terms of beds is reasonable good (as compared to the prescribed norm of 5 beds per 1000 population as per the UDPFI). However, the accessibility of this infrastructure is not adequate as there is geographical disparity in their distribution as most of these hospitals are located in the core of the city (source: Master Plan for Guwahati Metropolitan Area 2025).

In order to manage emergency situations like outbreak of diseases/ epidemics in the wake of disasters, medical response has been identified as one of the Emergency Support Functions (ESF-4) under the Kamrup Metropolitan District Disaster Management Plan. The Plan defines Standard Operational Procedures (SOP) to be followed for emergency response. The office of the Joint Director, Health Services (Kamrup Metropolitan District) (JD-H) is the nodal agency for carrying out ESF-4 functions in coordination with GMC, Blood banks, Indian Red Cross Society, private nursing homes, NSS, Rotary Club, Lions Club, Ambulance Services and medicine stockiest. Apart from this, two rapid response medical relief teams have been formed in the District Head quarter (D.C. Office) and one 24 hrs. control room has been set up in the office of the Joint Director, Health Services (Kamrup Metropolitan District) for surveillance. However, the SOP focuses more on response and relief measures and needs to bring in substantial measures for preparedness and recovery. The major observations outlining the gaps for the health sector have been listed below.

Table 11-9: Gaps and issues in the health sector

Issue	Description
High susceptibility to water & vector borne diseases	Based on the observations of the Total cases for Presumptive Surveillance in Guwahati city reported under the Integrated Diseases Surveillance Project (IDSP), on an average, about 10% of the total OPD attendance was for water and vector borne diseases. Another major share in incidence of diseases is that of respiratory problems which account for about 11% of the total OPD attendance. The data shows a definite seasonality of diseases, with an inclination towards the monsoon and post-monsoon months. Even the respiratory infections tend to increase in the post monsoon months.
Shortage of doctors	There is an acute shortage of doctors and paramedical staff in the government hospitals. As per the figures reported for IDSP in September 2012, there are only 107 doctors (1:9000 persons) and 293 paramedical staff members (1:3300 persons) in these hospitals. In such a scenario, the city is largely dependent on the private sector for health care facilities. As a result, it becomes difficult for middle- and low-income groups to bear the treatment costs incurred here, making them mostly unaffordable and inaccessible to the poor. The situation is aggravated by the fact that Guwahati city is a major urban centre and state capital and a lot of patients from all over the state come to the city for availing health facilities

## **11.3 Disaster Occur in Guwahati City**

According to the Assam State Disaster Management Policy (2010), landslides and urban floods are the two most prevalent hazards that undermine the urban development of Guwahati. A number of landslides have occurred in Guwahati in recent past causing extensive damage to life and property and have adversely impacted economic development. Continuous rainfall during monsoon aggravates the situation by causing more soil erosion associated with siltation. The poor and socio-economically weaker sections living in marginal and fragile areas are the most affected and vulnerable communities. Apart from these location in high seismic zone also makes Guwahati quite vulnerable.

### **11.3.1 Flood**

The tributaries of the Brahmaputra have widely divergent characteristics in the district. 45 per cent of Assam's total area is flood prone. The Brahmaputra River with its 34 tributaries causes regular floods in the state. The average annual rainfall in the state is 1662.2 mm. Ninety per cent of the heavy downpour occurs in the months of April-September. In 1999, more than 200 villages were inundated, and 0.27 million people in 749 villages of 10 districts were affected. In the year (2001), 94,382 people in 12 districts and 483 villages were severely affected. Road and rail communication was cut off in many districts. In 2000 alone, 3 million people lost their homes and vast stretches of paddy were swallowed by floodwaters. During 2002 floods 41 people have lost their lives, 19,827 houses damaged, and 0.3 million hectares of cropped land has been affected. During 2003, 30 people have lost their lives, 4660 houses have been damaged, and 0.2 million hectares cropped area has been affected.

The city of Guwahati experiences recurrent flood inundation and severe water logging in the occurrence of storm events and particularly during the rainy season, it has become a public grievance. Rapid urbanization with increased housing and construction activities in the city leading to increased buildings, streets and other impervious hard surfaces, and more importantly the absorption of inland wetland pockets and clogging of drainage systems has led to indiscriminate flooding. This has resulted in decreasing land capacity to soak up and carry excess water. Moreover, the unplanned expansion of the city to accumulate increasing population has led to severe encroachment in the wetlands, low lying areas, hills and shrinkage of forest cover. These denuded hills and loss of wetlands thus lead to artificial floods and water

logging. Immediately after every down pour the city drains gets silted up with silts coming with storm water running down the hills flooding the streets. The wetlands also cannot accumulate the excess storm water of the city.

Six nos. of natural channels namely: Bharalu, Bahini, Mora Bharalu, Basistha and Pamohi River passes through Guwahati. Guwahati also has three nos. of water bodies namely: Sorusola, Borsola, Silsako and Deepor Beel. During monsoon overtopping of these natural channels and water bodies causes water logging and inundation of the many areas in and around Guwahati city. Moreover, storm water coming from Meghalaya during monsoon is also one of the reasons for water logging of the Guwahati city. The areas which are mostly affected due to urban flood are:

Table 11-10: Flood affected areas in Guwahati and Dispur revenue circle

Sl. No.	Name of the revenue circle	Areas affected.
1.	Guwahati Revenue Circle	Lachit Nagar, Noonmati, Chandmari, Bamunimaidan, Pub Sarania Lane No.1-4, Rajgarh Byelane No 1 to 7, Zoo Road, Gandhi basti,
2.	Dispur Revenue Circle	Dispur Revenue Circle: Anil Nagar, Nabin Nagar, Tarun Nagar, Hatigaon, Sijubari, Lakhimi Nagar, beltola, NH37, Fatasil Ambari, Barshapara, Odalbakra, Bhaskar nagar, Dhirenpara, Bathoupuri, Katahbari, Patharquary, Narengi, Jyotikuchi, Dhapolia, Betkuchi

Source: District Disaster Management Plan, Kamrup Metro (2021)

Table 11-11: Flood occurrence in Guwahati and their Impacts

Sl. No.	Year of Occurrence	Area Affected (Ha.)	Population affected
1	2014-15	27,565	1,55,770
2	2015-16	NIL	20000
3	2016-17	5540	37214
4	2017-18	NIL	25,700
5	2018-19	NIL	145035

(Source: Department of Disaster Management, Kamrup)

Table 11-12: Flood disastrous details

Disastrous Event	Year of Occurrence	Area Affected	Name of localities	Population affected
Flood	2014, 2015, 2016, 2017, 2018, 2019 & 2020	GMC wards, North Guwahati & Villages	Mazir Gaon, Panikhaiti Rowmari, Sunsulai No. 2 kharghuli, Sila Grand, Kamakhya Gaon, Kharghuli N.C., Amingaon, Uzan bazar, North Guwahati, Fullung	3,83,719 (2014-19)

(Source: Department of Disaster Management, Kamrup Metro)

### Elements at Risk:

The key factor that contributes to vulnerability of human populations/ infrastructures to disasters are-

- Peoples residing along the bank of Bharalu, Basistha, Borsola, Sorusola, Silsako, Pamohi and their property
- Peoples residing in the flood affected villages of North Guwahati and Dispur, Guwahati, Azara, Chandrapur, Sonapur Revenue Circle
- The slum pockets in the city which is about 12.16% of the total population of the Municipal area. During rainy season most of the slum areas becomes waterlogged due to which the existing kutcha roads as well as graveled roads has become badly damaged.
- Babies of age group 0-6 years (1,09,829 as per 2001 census)
- 5,53,296 number of female (2011 Census)

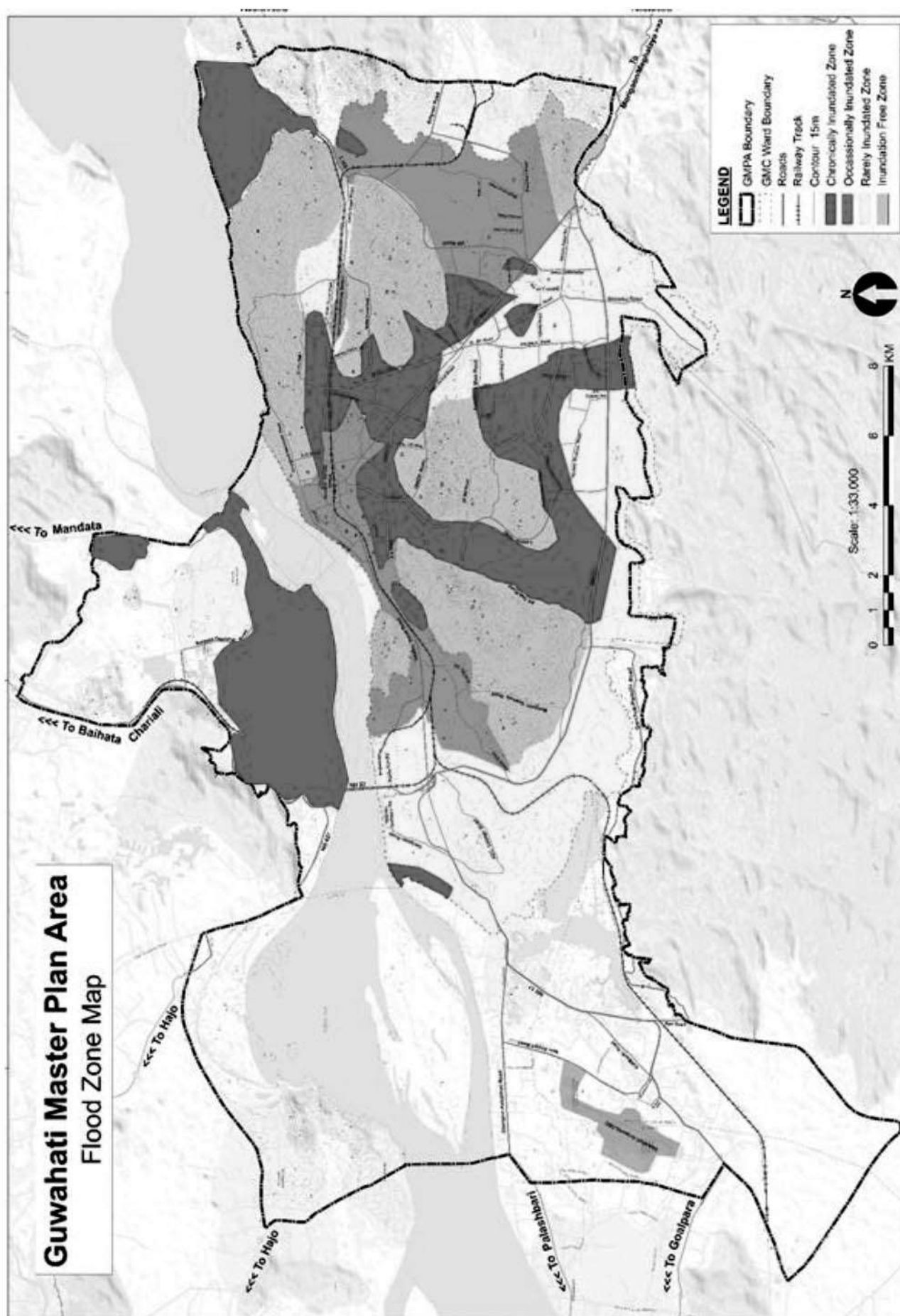


Figure 11-7: Flood Prone Areas in GMPA



### 11.3.2 Landslide

Occurrence and damages caused by several major landslide events in Guwahati. The first major landslide of Guwahati city took place in Nabagraha area in 1972. This was followed by other major slides in Dhirenpara, Dispur, Kacharibasti, Rupnagar, Madgharia, Sarania, Kalapahar Colony Bazar Hillside, Kharguli etc. Although the twenty-eight major landslide effected areas were identified in Guwahati city (Bora, 2002). In the study area, landslides have been reported from Chunsali Hill, Japorigog Hill and Sarania Hill. The first landslide in the study area was reported in the year 1990 in Sivanagar locality of 2 No. Mothgharia situated on Japorigog hill. No casualties were reported. On 23 July 1993 and 3 August 1999, landslides took place in South Sarania on Sarania hill without any loss and much damage to human life and property. Again in July 1995, 144 another landslide occurred in New Sarania area on the same Sarania hill. But the 19 June 2000 landslide in Bapuji Nagar, Noonmati area on Chunsali hill took three valuable human lives besides leaving one person injured with the destruction of two houses.

Rainfall-induced landslides constitute a major hydro-geological hazard and form a significant component of the natural disasters that affect most of the hilly regions round the globe. Apart from causing injuries and loss to life, landslide also adds to the woes of the suffered communities by causing destruction of infrastructure and communication routes. Landslides are considered to be one of the most potentially predictable of geological hazards, affect discrete areas of land and amenable to avoidance, prevention and correction measures.

landslides are a frequent phenomenon in Guwahati owing to flooding and the soil characteristics. This year also (2012), 10 people died due to a land slide in the city. In the past few decades, increasing frequency of landslides have become a concern for the Guwahati city especially around the low-lying hills. Encroachment due to growth in settlements on these hills has led to slope modification thereby making the land more vulnerable. According to ASDMA, among all natural hazards, landslide has caused maximum loss of life in the last 20 years<sup>27</sup>.

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<sup>27</sup> Climate Proofing Guwahati, Assam: City resilience strategy & Mainstreaming Plan,



Figure 11-8: A) Hill without vegetation cover (Lokhra) (B) Cutting of hills for construction of road in Khanapara (C) Debris landslide occurred at Lalungaon (D) Rockfall landslide at Sonaighu<sup>28</sup>

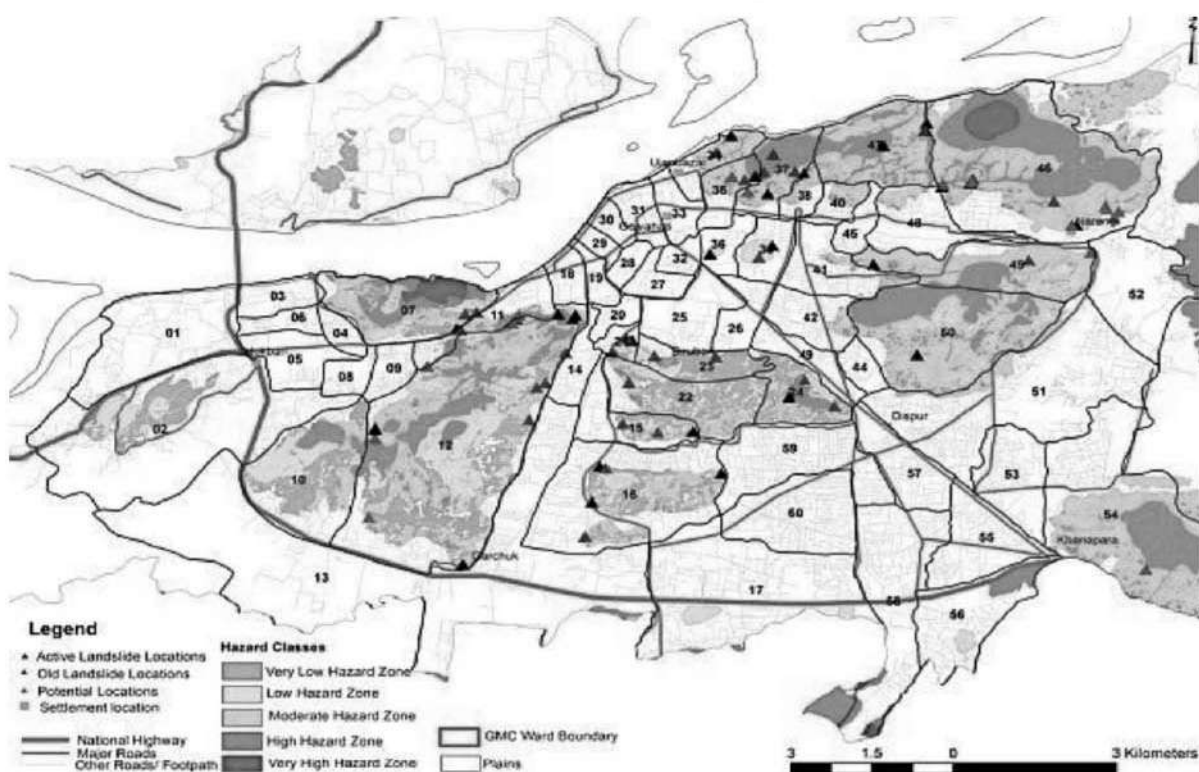


Figure 11-9: Landslide Prone Areas in GMC Area<sup>29</sup>

<sup>28</sup> Suman Das, Ranjit Kumar Ray, Gourav Nain, 2014, GIS Based Landslide Hazard Zonation of Guwahati Region, IJEDR

<sup>29</sup> Arindam Dey, Importance of Antecedent Precipitation and its Pattern on Landslide Studies A Case Study of Guwahati, Assam, IIT Guwahati

Table 11-13: Details of Casualties Occurred During Landslides in Guwahati

Year	No. of Deaths	Localities
2014	9	Nabagraha, Sunsali hill series, Japorigog hill,
2016	6	Sonaighuli & Jutikuchi hill series, Narakashur hill,
2017	1	Nilachal hill, Fatasil hill, Jalukbari hill, Khanapara hill, Agyathuri hills.

(Source: Department of Disaster Management, Kamrup Metro)

### 11.3.3 Earthquake

#### 11.3.3.1 Earthquake History in Assam and its Neighbouring Area

Much of Assam lies in the Brahmaputra River Valley, except for a few southern districts. The northern and eastern parts of this valley are bounded by the Himalayan Frontal Thrust (HFT). In the eastern parts along with the HFT, there are the Lohit and Naga Thrusts. The major earthquakes in this region were the events in 1969 and 1897. The 1897 earthquake is well known for the dramatic accounts of violent throw ups during the shock.

#### 11.3.3.2 Seismic Hazard

The entire state of Assam lies in Zone V. Here earthquakes of up to MM intensity IX can be expected.

#### 11.3.3.3 Significant Earthquakes in Assam

Both instrumented and non-instrumented events may be listed below. Reported magnitudes are listed for instrumented events while maximum observed intensities are listed for non-instrumented shocks.

The region comprises all Indian Territory to the east of north Bengal. This (also other neighbouring countries like Bhutan) from the most severe is micro regions in the world having experienced more than 350 known earthquakes of Magnitude 5 and over, among which 15 had magnitude 7 or more on the Richter Scale. The Assam quake of 1897 (M-8.7) is the largest earthquake ever known and the Sadiya earthquake of 1950 (M-8.6) was one which has rarely repeated. These earthquakes were so large that even topographical changes of levels etc., took place but the loss of life was not so great, since the population in 1897 was not as large, and the 1950 earthquake occurred in a rather unpopulated region. The Assam type construction using bamboo posts and Ekra-walling was light as well as strong and remained undamaged during these earthquakes. Recently on August 6, 1988, a M+7.2 earthquake occurred in the region.

Northeast India is seismically one of the six most active regions of the world, the other five being Mexico, Taiwan, California Japan and Turkey. It is placed in zone 5, the highest zone, of the seismic zonation map of India. It lies at the junction of Himalayan arc to the north and Burmese arc to the east. The region has experienced 17 large earthquakes ( $M \geq 7$ ) during the last hundred years including the great earthquakes of Shillong (1897,  $M=8.7$ ) and Assam-Tibet border (1950,  $M=8.7$ )

Guwahati did not experience being epicentre for earthquake, although it has experienced severe impact of earthquakes from neighbourhood areas. Recently A strong earthquake of magnitude 6.1 struck the Myanmar-India border region, its tremors felt In Kolkata, Guwahati.

Table 11-14: The Most Devastating Earthquakes in Assam in the Recent years

Sl. No	Place	Year	Magnitude	Remarks.
1	Shillong Plateau	June 12, 1897	8.7	About 1542 people died loss of 35 lakhs
2	Upper Assam	Aug 15, 1950	8.7	About 1520 people died. One of the latest known quakes in the history

Table 11-15: Major Earthquakes in the North Eastern Region and Neighbouring Area

Place	Year	Magnitude	Remarks
Nepal	April, 25, 2015	7.8	Destruction of huge amount of property and more than 8000 people died, more than 19000 were injured, and 250 people were injured.
	May, 12, 2015	7.3	Destruction of property, more than 200 people
Sikkim	Sep., 18, 2011	6.9	Destruction of property, 119 people died.
Bhutan	Sep, 21, 2009	6.2	Destruction of property
Cachar	March 21, 1869	7.8	Numerous earth fissure sands and craters
Shillong	June 12, 1897	8.7	About 1542 people died
Sibsagar	Aug 31, 1906	7.0	Property damage
Mayanmer	Dec 12, 1908	7.5	Property damage
Sree mangal	July 8, 1918	7.6	4500 km <sup>2</sup> area suffered damage
SW Assam	Sep 9, 1923	7.1	Property damage
Dhubri	July 2, 1930	7.1	Railway lines, culvert sand bridges cracked
Assam	Jan 27, 1931	7.6	Destruction of property
Nagaland	1932	7.0	Destruction of property

N-E Assam	Oct 23, 1943	7.2	Destruction of property
Arunachal	July 7, 1947	7.5	Destruction of property
Upper Assam	July 29, 1949	7.6	Severe damage
Upper Assam	Aug 15, 1950	8.7	About 1520 people died. One of the latest known quake in the
Patkai Range	1950	7.0	Property damage
Manipur-Burma Border	1954	7.4	Property damage
Darjeeling	1959	7.5	Property damage
Indo-	Aug 6, 1988	7.5	No Casualty reported

(Source: R.P. Tiwari Status of Seismicity In The Northeast India And Earthquake Disaster Mitigation, Department Of Geology, Pachhunga University College, Mizoram University, Aizawl 796001, Mizoram).

### 11.3.4 River Erosion

River erosion is a season specific calamity observed in certain period of time mostly in fixed seasonal interval. In rainy season specifically from months April to July, when Brahmaputra river flows in its peak capacity level, the erosion on banks becomes disaster for the bank settled informal settlements. Continuous rainfall during monsoon aggravates the situation by causing more soil erosion associated with siltation.

### 11.3.5 Cyclone & Storm

At least 45 people have died and around 4,000 were injured in the worst cyclonic storm to hit India's north-eastern state of Assam in 2005. The storm was so severe, number of people were blown away and some are still missing. The local severe storms of Guwahati during the pre-monsoon season are termed as Bordoichila, meaning the angry daughter of Assam. The destructive nature of Bordoichila has made a challenge for the meteorological community to develop a tool for precise forecast of the event.

## 11.4 Seasonal Hazard Analysis

PROBABILITY PERIOD / SEASONALITY OF DISASTERS												
Name of Disaster	Month											
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Flood												
Cyclone												
Fire Accident												
Earthquake												

Figure 11-10 Seasonal Hazard Analysis

- **Earthquake:** As per the latest seismic zoning map of India, the Kamrup Metropolitan district falls under High-Risk Zone- V, where a maximum intensity of IX can be expected.
- **Flood:** The general reason of occurrence of flood in Kamrup Metropolitan district is due to overflow of river Brahmaputra and its tributaries, mainly Bharalu, Kolong and Digaru.
- **Soil Erosion:** The soil erosion is major threat to many places in Kamrup Metropolitan district in the Azara and Chandrapur Revenue Circle.
- **Fires:** The fire takes places in Kamrup Metropolitan district mainly due to short circuit and careless handling of domestic LPG cylinders in the houses. Mainly fire takes place from March to April when the climate remains very dry and probability is more instance of fire breakout.
- **Cyclone:** Air communication to the Capital of the state is likely to be affected if a cyclone affects Lok Priya Gopinath Bordoloi International Airport Airport.



## 11.5 Disaster Vulnerable Area Mitigation Plan

Any disaster management plan or emergency management plan consists of four phases, namely: Mitigation, Preparedness, Response and Recovery. The mitigation component in an emergency management plan is aimed at reducing the risk, impact, effects of a disaster. Hence careful planning in the mitigation phase is important to reduce or eliminate the Long-term risk to human life, property from natural and manmade calamities. It's important to have mitigation plans led by local community, working together to identify, plan for in the event of a disaster and reduce vulnerabilities and promote long term personal and community resilience and sustainability. Mitigation plans can concentrate on both pre-disaster and post disaster efforts to reduce the impact of the disaster.

Pre-disaster Mitigation should focus on projects and interventions to address natural and man-made disaster to reduce risk to the population and property. This is mainly achieved by strengthening the resilience of National/State Infrastructures. Post-disaster Mitigation efforts are primarily designed to reduce future damage in an affected area and decrease the loss of life and property due to the incidents following the disaster. The essential steps of hazard mitigation are:

- Hazard Identification.
- Vulnerability Analysis.
- Defining a Hazard Mitigation Strategy.
- Implementation of Hazard Mitigation Activities and projects.

The Guwahati city is more prone to Floods and Landslide than any other natural disasters hence the disaster vulnerable area mitigation plan focuses on flood, cyclone, Landslide and Earthquake related

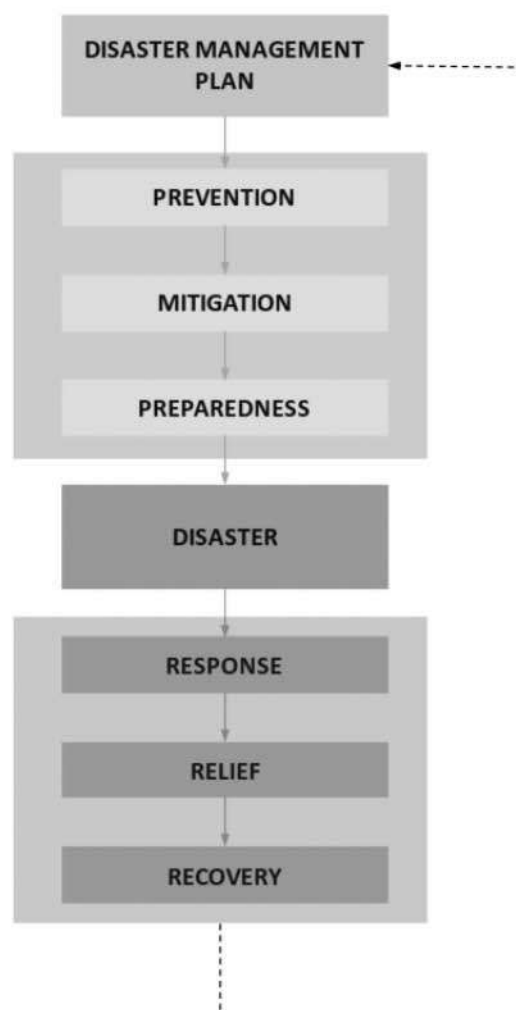


Figure 11-11: Disaster management plan

eventualities and how can it be mitigated and have a better preparedness. It is important to note that disaster management is an integrated task involving various

government departments of region and the plan should focus on prevention, preparedness, mitigation, response, and relief measures.

### **11.5.1 Prevention Plan**

#### **11.5.1.1 Measures need to be taken**

As part of prevention of the said natural disasters, the following measures can be adopted by concerned government departments to avoid and minimize the impacts of natural disasters.

- The Public Works Department should monitor the major water bodies like rivers, streams, lakes for constant flow of water, rising levels, and identify potential areas along the water bodies which need additional embankment or revetments, and these works should be implemented on priority before the onset of the season.
- Power and Communication should carry out through inspection of power lines, communication lines for defects and rectify them. Trees and branches which may damage power and communication lines should be trimmed or removed.
- Health department should ensure that the primary and community health centers are equipped with medicines and medical staff. Preventive vaccines for epidemics should be stocked in adequate quantity. Chlorination of drinking water should be ensured to avoid the outbreak of epidemics in the event of cyclones and floods.
- The Department of Disaster Management is the nodal agency in the Kamrup Metro Region and has already handled several flood and cyclone situation in the region. From this experience, it should be able to identify the low lying and vulnerable areas and the population of such places must be warned to be alert and to be ready to move to the cyclone shelters or to safer areas or to the relief camps in case of warning of disaster.
- The Department of Civil Supplies & Consumer Affairs should decide for creation of buffer stock of food grains by making required withdrawal from the Food Corporation of India. Also, adequate quantities of Kerosene and diesel should be procured and made available through the Fair Price Shops.
- Department of Agriculture should take steps to publicise precautionary measures to be taken to save the standing crops in the vulnerable areas. Farmers should be encouraged to have platforms in their fields to stock the crops. Desilting of public and private irrigation channels should be ensured for quick drainage of paddy fields.
- Fisheries & Fishermen Welfare Department shall alert all the coastal villages and hamlets about the impending natural calamity and advise the fishermen not to venture into sea till normalcy is restored.
- Department of School Education shall keep all schools ready for accommodating the evacuees and keep the Central Kitchens to function around the clock with in charge of the centers. NCC and NSS students shall also be grouped to send them for relief works.

- Transport Department should keep ready the list of sufficient numbers of earthmoving vehicles, transportation vehicles such as trucks, tractors, tippers, mini buses etc. Further, all the listed vehicles allocated in connection with calamity has to be kept in roadworthy condition for using them in emergency.
- Fire Services Department shall keep available adequate rescue materials, like life jackets, buoys, ladders and ropes.
- Department of Animal Husbandry & Animal Welfare should store fodder, cattle feed, poultry food etc. and also carry out the inoculation of animals against epidemics. The Key Village Units should harbor stray cattle with shelters.
- Local Bodies shall make arrangements for availability of Generators and pump sets at short notice. For areas with waterlogging Local bodies should clear the L & U type drains which normally clog due to plastic materials and silt.
- The Police Department shall set up a Search & Rescue Team which shall contain at least 20 Police Personnel for each jurisdiction of the Superintendent of Police.
- Similarly, the Fire Services Department shall set up Search & Rescue Team consisting of at least 6 members of each Fire Service Station.

Identification of hazardous locations in different Circles is to be done and marked on the map. Basically, these locations are found prone to fire, earthquake, and artificial flooding. Fires found to be spread out mostly as a result of narrow roads while artificial flooding because of poor drainage pattern. Northeast Space Application Centre has been entrusted to Hazard, Risk & Vulnerability mapping of GMPA by Assam State Disaster Management Authority. Master Plan of Drainage pattern is to be completed by Town & Country Planning.

There are 2 types of majors Structural and non-structural i.e., Steps are to be taken to mitigate the problems out of erosion, threat to DTP dyke, banks of Brahmaputra & Buridehing, Fire & Earthquake and Training of Village Land Management and Conservation Committee Members (VLMCC) on preparation of Village Master Plan and Constitution of Ward Disaster Management Committee in 31 wards of Guwahati Municipal Corporation.

The activities of different line departments to save the life of people and properties in accordance with disaster management cycle. Police departments, Police control room, Wireless facilities, Fire and emergency services and civil defense and home guard.

Table 11-16: Measures to be Taken for Prevention Plan

Sl. No.	Structural measures	Non-structural measures
1	Installation of Water Collection Deep Tube Well Pumps at five selected sites to be used for firefighting purposes	Training of Village Land Management and Conservation Committee Members (VLMCC) on preparation of Village Master Plan
2	Water Pumps to install in identified locations to pump out logged water	Constitution of Ward Disaster Management Committee in 31 wards of Guwahati Municipal Corporation Plan and follow up action
4	Redesign existing storm water and drainage systems in flood prone areas	Training of Doctors on Emergency Health & Mass Casualty Management
5	Erosion protection works in vulnerable reaches along the bank of river Brahmaputra and Buridehing including breach closing works	Training of Engineers on Rapid Visual Screening
6	Undertake structural safety audit of lifeline buildings and schools	Workshop on Earthquake Risk Mitigation and Management
7	Undertake structural safety audit of Shopping Malls, Nursing Homes, multistorey buildings	Training of Task Force Members (Quick Response Team) on Search, Rescue and First Aid
8	Map locations of all key buildings in the District and rate them on the basis of rapid visual screening exercise/ Non-Destructive (ND) Test	Earthquake Shakeout programme in schools
9	Undertake retrofitting of key lifeline and critical/ social infrastructure	Training of Principal/ Head Masters of HS/High/ME/LP schools on School Safety & Disaster Management
10	Adopt zoning parameters as identified in the Model Building Byelaws issued by MHA (Sept. 2004)	Mock exercises in several locations
11	Fire Safety Audit of Shopping Malls, multi-storied buildings as per underlying norms National Building Code	Training programmes on Disaster Management conducted for the officers & staff of different vital Govt. establishments
12	Enforcement of National Building Code/Indian Standard Code of Practice (BIS) and Assam Notified Urban Areas (Other than Guwahati) Building Rules, 2014	Disseminate alert and warning mechanisms of flood early warning system (FLEWS) project to communities (preferably through VLMCC)
14	Conduct detail flood hazard mapping of the district	Promote flood insurance
15	Map all infrastructure at risk to varying intensity of flood hazard	Disseminate flood hazard mapping information to stakeholder
16	Identify areas prone to sediment built up and measures to take up	Undertake Mock Drill on flood rescue

### 11.5.2 Mitigation and Preparedness Plan

Disaster planning consists of activities such as pre disaster mitigation and disaster preparedness. Disaster mitigation focuses on the hazard that causes the disaster and tries to eliminate or drastically reduce its direct effects. The best example of mitigation is the construction of embankments and construction of proper drainage system in flood prone areas & urban locality to avoid floods / flash flood. The other example includes retrofitting of weak life line buildings to make them earthquake resistant. And preparedness focuses on plans to respond to a disaster threat or occurrence. It takes

into account an estimation of emergency needs and identifies the resources to meet the needs. The first objective of the preparedness is to reduce the disaster impact through appropriate actions and improve the capacity of those who are likely to be affected most. The second is to ensure that ongoing development continues to improve the capacities and capabilities of the system to strengthen preparedness efforts at community level. Finally it guides reconstruction so as to ensure reduction in vulnerability. The best example of preparedness activities are the development of community awareness and sensitization system through community education and administrative preparedness by way of stockpiling of supplies, developing emergency plans for rescue and relief.

### **Specific Disaster Mitigation Measures**

#### **11.5.2.1 Earthquakes**

Kamrup (M) district falls under earthquake zone-V so following mitigation measures should be taken to reduce the impact of earthquake:

- Implementation of Building Bye- Laws for new construction in various areas.
- Public utility buildings must be located in stable areas or in stiff soil.
- Retrofitting of weak structures.
- Relocation of people settling in the steep slope areas and near the river bank.
- Assessment of lifeline buildings and strengthening the same

#### **11.5.2.2 Flood Mitigation**

Flood mitigation refers to the measures aimed at prevention and preparedness. It reduces the actual or probable impact of floods on the people and their environment. Floods in Kamrup Metro district are inevitable, considering the topography and the river system. What is required is a system of adjustment with floods, so that the people experience minimum of disruption and damages. The objective of flood mitigation is to control changes in the volume of run-off, peak stage of the flood, time of rise and duration of floodwaters, and location of flooding. The main causes of floods in Kamrup Metro District are:

- Obstruction in drainage system due to heavy rainfall.
- Increase in siltation resulting rise in riverbeds due to erosion in the catchment areas.
- Poor natural drainage system
- Unplanned development of city
- Release of water from NEPCO hydel project



The mitigation measures should be oriented to take proper care of these problems and thus will automatically reduce the impact of flood in the district. The various measures adopted for flood mitigation may be categorized in two groups structural and non-structural.

#### Structural

- Construction of embankments / floodwalls along the river bank and improvement of the channel (by WRD)
- Construction of drainage system in the Roing town and other parts of the district (by PWD/UD).
- Diversion of flood water (by WRD).
- Careful location of new facilities, particularly community facilities such as schools, hospitals and other important infrastructure away from flood prone areas.
- Reforestation of hilly train around the city
- Construction of retaining wall at the landslide prone areas

#### Non-structural

- Law enforcement and eviction drive
- Cleaning of drain in regular interval
- Awareness drive among the communities towards garbage disposal
- Collection of daily rainfall data (by WRD).
- Flood forecasting and warning (by WRD & General Administration).
- Prepare detailed floodplain map of the district, based on extent of land submerged, and assessment of damages. Analyze how the pattern of flooding has changed over a period (by WRD & GA).
- Plantation in the catchment areas to check soil erosion (by forest dept),
- Preparation of GDMP and awareness programme through IEC (information, education & communication by GA).

#### **11.5.2.3      *Cyclonic storm***

Kamrup Metropolitan District is usually strike by cyclonic storm (Bordoichilla) during pre-monsoon season causing widespread damage to the crop and other properties. The main mitigation strategies for storm hazards are a well-informed public and an effective warning system. The following mitigation measures can be adopted to reduce the impact of cyclonic storm:

- Location of key facilities in leeward sides of hill/ less vulnerable areas (by District Administration and Land Management).
- Planting windbreaks in the most vulnerable locations (by DFO (T)).
- Construction of strong, wind safe public buildings which can be used for community shelter in settlements (by UD & PWD).



- Crops can be protected by introducing agricultural practices and cultivation of those crops which are more resistant to high winds.
- Compilation of meteorological data for forecasting of storm (By Dept concerned).
- Public dissemination of information through mass media, poster campaigns and village meetings (by Distt Administration).
- Regulation should be bringing to restrict installation of mobile tower over RCC Building in residential areas

#### **11.5.2.4      *Landslide***

Landslide is very common in the hilly terrain of Guwahati city. Loss of Human lives and animals lives are also observed during rainy season. Landslide can be caused by poor ground conditions, geomorphic phenomena, natural physical forces, improper land use pattern and quite often due to heavy spells of rainfall coupled with impeded drainage. The chief mitigatory measures to be adopted in the district are:

- Correction of drainage systems in the landslide prone areas by maintenance of natural drainage channels both micro and macro in vulnerable slopes (by BRO/PWD).
- Regulation of land use pattern (Land Management).
- Forestation of areas occupied by degraded vegetation (by DFO (T)).
- Re-location of settlements that are in the landslide prone areas (by GA).
- Construction of gabion structure in important areas (by WRD).
- Creation of awareness among local people (by DDMA).
- Regular observation of rainfall pattern (by WRD).
- Turfing of newly constructed high land

#### **11.5.2.5      *Fire Accident***

Fire accident is very common in Guwahati City of Kamrup (Metro) District due to compact settlements and in other parts of the district thatch roof houses which is very prone to fire. The following mitigation measures may be taken up to contain fire accident:

- Installation of fire extinguisher cylinders in all institutions (by concerned institute).
- Construction of fire hydrant in fire prone areas (by PHED/Police/GA).
- Installation of fire warning systems in community facilities such as in school and hospitals (by concerned institute).
- No attachment of thatch houses in govt buildings (by GA).
- Awareness about the causes of fire accident in rural areas and motivate the villagers to construct their houses at sufficient distance from one another (by GA).

**11.5.2.6      Epidemics**

The Health Department & Veterinary dept is the nodal agency responsible for monitoring and control of epidemics. Mitigation measures for control of epidemics would include:

- Identification of areas prone to certain epidemics must be updated to access field requirements (by DMO & DVO).
- Testing laboratories in district hospital must be well equipped and updated (by DMO).
- Regular flow of data from both govt establishment and NGOs run hospitals (by DA).
- Analyzing and collating the data at regular intervals to access epidemiological monitoring requirements (by DMO/DVO).
- Awareness campaign to the PRI members and the villagers about various kinds of disease and their causes that are prevalent in the area (by DMO/DVO/DA).

**11.5.2.7      Road accidents**

Many lives were lost, and casualties are reported annually due to road accident, which is cause due to reckless driving and poor road conditions. The following measures may be adopted to mitigate road accidents:

- Opening of traffic model school in every district.
- Installation of speed monitoring machine in busy areas (by police).
- Strict implementation of motor vehicle Act (by Police).
- Installation of traffic sign boards (by Police).
- Carry of First Aid Box in every vehicle must be made mandatory (by Police/DTO (transport)).
- Insurance of all vehicles must be updated (by Police)

### 11.5.3 Response Plan

Response measures are those taken immediately prior to and following disaster impact. It is important to have clear organization structures with established line of authority within the government mechanism to handle the response plan in case of natural calamities. The plan should detail out the various phases from early warning to rehabilitation and the roles that agencies play in reaching the vulnerable and affected to identified disaster support infrastructure located in the GMPA Region. Response plans include formation of functional teams and providing plans for transportation, evacuation, search and rescue, and rehabilitation. They are supported by supervisory zone-based teams assuring food, shelter, water, medicine to the vulnerable to uphold physical and psychological health. Survey and assessment should be the part of response activity.

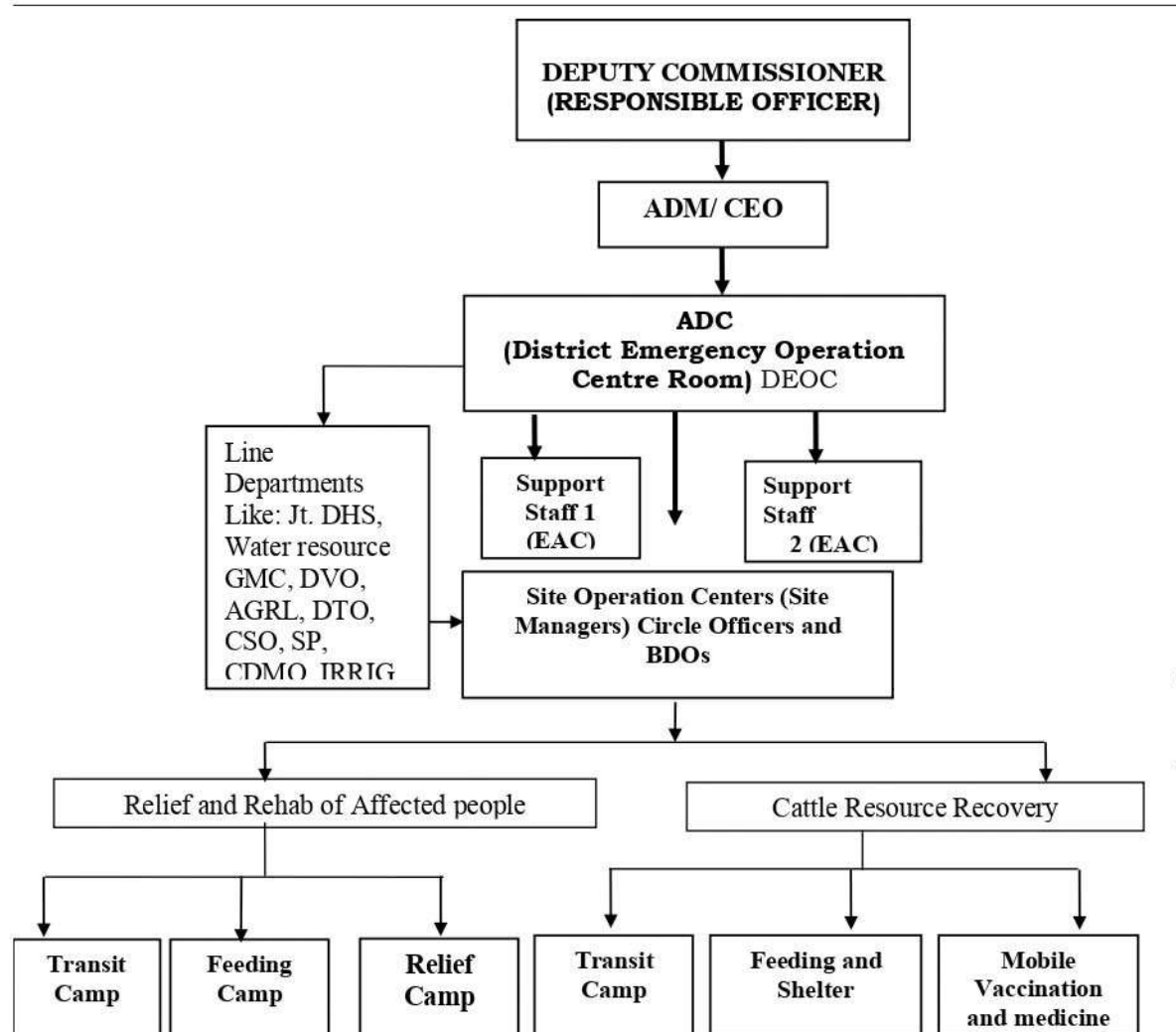


Figure 11-12: Resource Mobilization during Response

**11.5.3.1      *Emergency Support Functions (ESF) & Incident Command System:***

The Emergency Support Functions (ESFs) are various identified response teams, which will assess their strength before any emergency and accordingly will prepare their Standard Operational Procedures to mitigate any disaster. Their well preparedness will help to reduce the damage of any disaster/emergency. These ESFs will be identified as per the certain need felt during any disaster such as ESF-Warning (Communication), ESF-Road Debris Clearance, ESF Relief etc. Hence The Emergency Support Functions (ESFs) provide vital response functions. The Emergency Support Functions at District level (Office of the Deputy Commissioner) will be replicated at Block level (by Block Administration) and the Incident Management Team consisting of all the ESFs would also activate itself by asking for some or all ESFs to be represented in it, according to need of the crisis. The Disaster Response Mechanism will be operated as per basics of Incident Command System where the Deputy Commissioner is the Incident Commander for the District Level Incident Management Team and will be supported by the Planning, Operation, Logistic and Finance Section Chiefs in effective management of the response. National Disaster Management Authority has categorized the level of disasters as L0, L1, L2 and L3. Based on the ability of various authorities to deal with them. L0 denotes normal time, L1 is the disaster that can be dealt with at district level, L2 specifies the disaster that requires assistance and active participation from the state. L3 disaster requires assistance from the Government of India.

For an effective operational system of the ESFs the following points are to be ensured:

- Individual ESFs must prepare their Standard Operational Procedures (SOP) and Plan
- These plans would be integrated to form the District Response Plan
- Time to time each ESF will practice their simulation exercise (Mock Drill) to under their lacunas.
- They have to update their response system regularly.

To act as a bridge to support an information base among the emergency Operation Centres of State, District and Onsite level, there as to be one District Emergency Operation Centre (DEOC) operation system and is to be operational under district EOC to collect information from grass root level, district level as well as from State level. As said, the DCR will act as a vital linkage among the Emergency Operation Centre of State, District and Onsite. The list of 16 identified Emergency Support Functions, its Team Leaders and the supporting agency provided in Table 11-17.

Table 11-17: Emergency Support Functions, Team Leaders, and Participating Agencies

Emergency Support Function (ESF)	Function	Team Leader	Participating agencies
ESF 1	Warning (Communication)	S.P., Police,	Meteorology (IMD), CWC, Water resources (E&D), Radio, Doordarshan, DIPRO, Telephones, IWT, Police
ESF2	Evacuation (Search and Rescue)	Addl. District Magistrate	Police (VDP), Fire services, Civil Defence, Home Guards, Zila Sainik Board, (NCC), NYK, NSS, Forests, Social forestry, Soil Conservation, PWD(R),PWD(Bldg), Sports, IS (Scouts & guides) Inspector factory & Boilers, PRIs.
ESF3	First Aid & Medical Response	Jt. Director Health Services	Health & FW, Red Cross, DSWO, ICDS, Medical, Ayurveda, Homeopathy faculty/ Students, Asst Labour Commr, Veterinary
ESF4	Relief & Coordination (Food-Shelter)	ADC (Relief)	Food & civil supplies, FCI, Statfed, Warehousing Corporation, Revenue & Relief (Circle officers, BDOs, LM/ Gram Sevak/ Gaon-Bura), Veterinary, Fisheries, Agriculture, Agri(Marketing)
ESF 5	Water & Sanitation	E.E ( P.H.E)	PHED, DRDA, PRIs, Municipality /T & C, Irrigation, Agri (Eng)
ESF6	Shelter Management	ADC ( Relief)	Revenue (CO, BDO, LM/ Gram Sevak /Gaon-bura), DRDA, PRIs, Police (VDP), NCC, NSS, DTO, Railways, Taxes, IWT, PWD (for boats etc)
ESF7	Carcass Disposal	District Animal Husbandry Officer	,Water resources (E&D), ASEB, Forests, DIC, Housing, IS, DEEO Animal Husbandry department of Block level and district level, ULBs Animal medicine stockiest, NGOs, Voluntary Organizations, CBOs, religious organizations
ESF8	Damage Assessment Team	Deputy Commissioner (Land Reforms)	Revenue & All departments
ESF9	Trauma Counseling	Jt. Director Health Services	Medical & FW, DSWO, Red Cross, ICDS
ESF10	Patrolling	Suptd. Of Police	Police(VDP, Nagarik Samities), Zila sainik Board, IS(NSS), YC(NYK)
ESF11	Logistics (Traffic-Electricity-Water	ADM (Nazarat)	DC Office, Electricity Board, Transport Dept,Public Health Engineering Dept.,Municipality, Private Road Ways, PWD (Road), NH Division
ESF12	Transport	District Transport Officer	Railway, PWD, Municipality, Civil Defence, Scout, NCC etc.
ESF13	Volunteers	Youth Coordinator NYK	NCC, NYK, Zila Sainik Board, Blood Bank, Red Cross, NSS, Rotary Club, Lions Club, NGOs & other organization

Emergency Support Function (ESF)	Function	Team Leader	Participating agencies
ESF14	Public Works	Superintending Engineer, PWD (Road),	PWD (Road and Building), Electricity Board, Public Health Engineering Dept Municipality etc.
ESF15	Road Debris clearance	Special Officer, Municipality,	Municipal Office, NCC, Scouts & Guides, Zilla Sainik Board, Divisional Forest Officer, NH Division I and II PWD (Road) and Nearest Army Cant.
ESF16	Public Information and Help lines	PRO	NGOs, Media (print/audio-visual), NSS, Scouts & Guides, Education Dept.,



### **11.5.3.2 Responsibilities and Functions of Operation Branches**

Incident Commander: Deputy Commissioner

In anticipation of any disaster, the district administration has taken various precautionary measures. Functioning of the Control Room, Closure of past breaches in river and canal embankments and guarding of weak points, rain recording and submission of rainfall report, communication of Gauge reading, functioning of flood/cyclone zones, deployment of power/country boats, installation of temporary VHF stations, arrangement for keeping telephone and telegraph lines in order, storage of food stuff, arrangement for keeping drainage clear, agricultural/health/veterinary measures, selection of flood/cyclone shelters, etc. have been properly planned. The government officials of different departments have been apprised of their duties for pre, during and post disaster periods. The Circle Officers, B.D.Os, ULBs, Executive Engineers of Irrigation Department, Health, Police, A & Veterinary and PHE etc. have been requested to take all precautionary and preparatory measures and to remain alert to face the challenge of any disaster. Every possible kind of cooperation from all the line departments has been sought for by the district administration in combating the severe natural calamities that may occur anytime. Accordingly, the government officials have also been apprised of their roles and responsibilities to be played during pre-disaster arrangement and during/post-disaster management.

ESF 1 Warning (Communication) :

The Emergency Support Function (ESF) 1 having the prime function of "Warning" (communication) will be led by the Superintendent of Police, Kamrup. However, during the crisis, when the ESF 1 will be deputed to the onsite EOC, the DSP may lead the team on behalf of SP, Police. The supporting agencies for the ESF 1 will Meteorology (IMD), CWC, Water resources (E&D), Radio, Door darshan, DIPRO, Telephones, IWT, Police and any relevant dept as decided by the ESF 1 during preparation of their Standard Operational Procedures (SOP). The primary functions of the ESF 1 (Communication) will be:

Primary Functions:

- Warning for any eventuality of calamity
- Restore Communication facilities after disaster
- Provide emergency communication for response to government: link EOCs, Quick Response Teams (QRTs) etc.
- Provide communication facility to communities

- Coordinate the requirements of temporary telecommunication in affected areas.
- Coordinate state actions to assure the provision of telecommunication to support the state and district.

#### ESF 2: Evacuation (Search and Rescue)

The Emergency Support Function (ESF) 2 meant for 'Evacuation -Search and Rescue' will be led by the Addl. District Magistrate, Kamrup. The supporting agencies for this function will be Circle Officers, Fire Stations, Police (VDP), Fire services, Civil Defence, Home Guards, Zila Sainik Board, (NCC), NYK, NSS, Forests, Social forestry, Soil Conservation, PWD(R), PWD(Bldg), Sports, IS (Scouts & guides) Inspector factory & Boilers, PRIs and any relevant dept. as decided by ESF 2 during preparation of their Standard Operational Procedures (SOP). Help of National Disaster Response Force (NDRF) may also be sought if felt necessary. The Primary Functions of the ESF 2(Evacuation -Search and Rescue) will be:

#### Primary Functions:

- Establishment of evacuation plans
- Identification of fastest evacuation routes and all alternative routes.
- Establish maintain and manage District search and rescue operations.
- Coordinate search and rescue logistics during a field operation

#### ESF 3 & ESF 9:

Emergency First Aid / Medical Response and Trauma Counselling.

The Emergency Support Function (ESF) 3 meant for 'Emergency First Aid / medical response and trauma counselling will be led by the Jt. Director of Health Service, Kamrup. The supporting agencies for this function will be Health & FW, 108 EMRI, Red Cross, DSWO, ICDS, Medical, Ayurveda, Homeopathy faculty/ Students, Asst Labour Commissioner, Veterinary, Dispensaries, Mobile Dispensaries, Hospitals, Ambulance Service, Blood Bank, etc and any relevant dept. and for ESF 9 " Trauma Counselling" the supporting agencies will be members of Guwahati medical college Hospital's Trauma Counselling team, Medical & FW, DSWO, Red Cross, ICDS and any relevant dept. as decided by ESF 3 & ESF 9 during preparation of their Standard Operational Procedures (SOP). The Primary Functions of the ESF 3 (Emergency Medical Response and Trauma Counselling) will be:

#### Primary Functions:

- Direct activation of medical personnel supplies and equipment.
- Activation of Mobile Medical team with first aid at each block/circle.

- First aid for minimum 25 persons should be kept in reserve with Mobile Medical team on rotation basis.
- Appropriate mass vaccination to check the waterborne epidemics.
- List out the available ambulances with all in formations.
- Mobilize emergency treatment for the injured people.
- Send quick response teams (QRTs) at various affected sites and establish temporary medical camps.
- Set up Trauma Counselling Desks.
- Perform medical evaluation and treatment as needed.
- Maintain patient tracking system to keep record of all patients treated.

#### ESF 4: Relief & Coordination

The Emergency Support Function (ESF) 4 indicated for 'Relief & Coordination' will be led by the ADM (Relief). The supporting agencies for this function will be Food & civil supplies, FCI, Warehousing Corporation, Revenue & Relief (Circle officers, BDOs, LM/ / Gaon-Bura), Veterinary, Fisheries, Agriculture, Agri (Marketing) any relevant dept. as decided by ESF 4 during preparation of their Standard Operational Procedures (SOP). The Primary Functions of the ESF 4 (Relief & Coordination) will be:

##### Primary Functions:

- Enter into a pre-contract system with the local Civil Suppliers for immediate arrangement of food and relief materials during the crisis.
- Ensure coordination of activities involved with the:-
  - Emergency provisions of temporary shelters
  - Emergency mass feeding and Bulk distribution of relief supplies to the disaster victims as also the disaster managers and relief workers.
- Control quality and quantity of food for relief
- Ensure timely distribution of food to people
- Make emergency food supplies available to population

#### ESF-5: Water & Sanitation

The Emergency Support Function (ESF) 5 indicated for 'Water & Sanitation' will be led by the E.E (P.H.E). The supporting agencies for this function will be PHED, DRDA, PRIs, Municipality /TC, Irrigation, Agri (Eng) any relevant dept. as decided by ESF 5 during preparation of their Standard Operational Procedures (SOP). The Primary Functions of the ESF 5 (Water & Sanitation) will be:

##### Primary Functions:

- Ensure provision of safe drinking water in the relief camps
- Arrange sufficient stock of hand tube wells
- Distribution of water disinfecting packets
- Ensure better sanitation arrangements as per Gender

- Ensure proper drainage facility
- Launch campaign for safe potable water to create awareness

#### ESF-6: Shelter Management

The Emergency Support Function (ESF) 6 indicated for 'Shelter Management' will be led by the ADC (Relief). The supporting agencies for this function will be Revenue (CO, BDO, / PRIs members /LM/ Gaon-Bura), DRDA, PRIs, Police (VDP), NCC, NSS, DTO, Railways, Taxes, IWT, PWD (for boats etc) ,Water resources (E&D), ASEB, Forests, DIC, Housing, IS, DEEO any relevant dept. as decided by ESF 6 during preparation of their Standard Operational Procedures (SOP). The Primary Functions of the ESF 6 (Shelter Management) will be:

##### Primary Functions:

- Provide adequate and appropriate shelter to all population
- Locate relief camps close to open traffic and transport links.
- Develop alternate arrangements for population living in structures that might be affected even after the disaster

#### ESF-7: Carcass Disposable (Cattle Resource Recovery and Care)

The cattle resource, as one of the important sustainable economic resources are highly affected or perished during any severe damage, though the same evolves as the vital input to revive the economy especially in the rural areas after any severe disaster. The (ESF) 7 designated for 'Carcass Disposable (Cattle Resource Recovery and Care)' will be led by the District Animal Husbandry Officer. The supporting agencies for this function will be Animal Husbandry department of Block level and district level, animal medicine stockiest, NGOs like Peoples For Animals, Voluntary Organizations, CBO's, religious organizations and any relevant dept. as decided by ESF - 7 during preparation of their Standard Operational Procedures (SOP). The Primary Functions of the ESF Carcass Disposable (Cattle Resource Recovery and Care) will be:

##### Primary Functions:

- Ensure Proper vaccination
- Keeping in view of Cattle as sustainable economic resource of rural people, ensure immediate Animal Feeding Camp with shelter at a distance of 500 mtr away from human Relief Camp.
- If possible, the human relief camp should be at higher contour height than the animal feeding camp.
- Ensure proper carcass disposal
- Mobile Veterinary medical team in the affected area.

- Ensure cattle transit camp at distance of 500 meter away from transit camp of affected people
- The astray cattle shall be kept in City level Goshalas (cattle charity mission).

#### ESF8: Damage Assessment Team

The Emergency Support Function (ESF) 8 designated for 'Damage Assessment Team' will be led by the Deputy Commissioner, Revenue. The supporting agencies for this function will be Revenue, All Line deptts, Block Damage Assessment Team, GP Damage Assessment Team, Village level Damage Assessment Team and any relevant dept. as decided by ESF 8 during preparation of their Standard Operational Procedures (SOP). The Primary Functions of the ESF 8(Damage Assessment Team) will be:

##### Primary Functions:

- Number of lives lost.
- Number of People Affected.
- Number of Houses damaged (category wise).
- Damage of Infrastructures like School, Hospitals, Govt. Buildings, Road, Electricity, Water Supply etc In coordination with relevant depts. assess the

#### ESF 10: Patrolling

The Emergency Support Function (ESF) 10 designated for 'Patrolling' will be led by the Suptd. of Police, Kamrup. The supporting agencies for this function will be Police (VDP, Nagarik Samities), Zila Sainik Board, IS(NSS), YC(NYK) and any relevant dept. as decided by ESF 10 during preparation of their Standard Operational Procedures (SOP). The Primary Functions of the ESF 10(Patrolling) will be:

##### Primary Functions:

- Ensure necessary security arrangements for public amenities
- Proper coordination with relevant departments
- Necessary security arrangements at Roads (N.H) Bridges, Culvert etc.
- Ensure necessary security to the officers and personnel engaged in Relief & Coordination

Further for effective coordination among all the Emergency Support Functions identified before any emergency, during the emergency and after any emergency. For this function, suitably the Deputy Commissioner, Kamrup will carry out the Task. Under this function all the Team Leaders of identified 'Emergency Support Function' such as S.P., Police, Addl. District Magistrate, Jt. Director Health Services, ADC (Relief), E.E (P.H.E), District Animal Husbandry Officer, CEO Zilla Parishad, Fire Services, Civil



Defence Officials, ULBs, para military force. Besides above, NGOs, NSS and other relevant departments of Kamrup may represent as per the requirement during any emergency. This team will keep direct link the District Control Room Operation and liaison with Block control Room Operation. The Deputy Commissioner, Kamrup will include the review of emergency support function system in the agenda of the District Coordination Meeting, will review the updation of the district disaster response system by incorporating the changes in names of officers, of telephone numbers and addresses of the officers concerned. The Deputy Commissioner should also take review of changes in other indicators pertaining to the district like creation of additional infrastructure, development projects, changes in inventories, etc. and incorporate these changes while updating the Plan and Standard Operational Procedures of each ESFs. The members should substantiate/assist the Committee with all the updated information about their concerned areas of operation time to time.

#### ESF-11: Logistics (Traffic- Electricity-Water)

The Emergency Support Function (ESF) 11 indicated for 'Logistics (Traffic, Electricity, Water will be led by the ADM (Nazarat). The supporting agencies for this function will be Deputy Commissioner Office, Electricity Board, Transport Dept, Public Health Engineering Dept., Municipality, Private Roadways, PWD (Road), NH Division and any relevant dept. as decided by ESF 11 during preparation of their Standard Operational Procedures (SOP). The Primary Functions of the ESF 11 - Logistics (Traffic-Electricity-Water) will be:

##### Primary Functions:

- Ensure smooth transportation links at all levels and to all nodal and support agencies.
- Assess damage to power supply infrastructure for assistance from other states.
- Restoration of power supply or temporary power supply to critical areas.
- Restore major electricity failure anticipated during disasters due to falling of cables/poles.
- Facilitate restoration of electricity distribution systems at most affected sites on priority to help in Search and Rescue operations.
- Provide electricity in lifeline buildings.
- Procurement of clean drinking water.
- Transportation of water with minimum wastage.
- Ensure quick restoration of drainage system.
- Sewer pipes to be kept separate from drinking water facilities.

#### ESF 12:Transport



The Emergency Support Function (ESF) 12 designated for 'Transport' will be led by the District Transport Officer. The supporting agencies for this function will be Railway, PWD, Municipality, Civil Defense, Scout, NCC etc. and any relevant dept. as decided by ESF 12 during preparation of their Standard Operational Procedures (SOP). The Primary Functions of the ESF 12 (Transport) will be

Primary Functions:

- Overall coordination of State transportation capacity.
- Pre-contract with the private Ambulance owners (during registration).
- Restoration of roadways services.
- Arrange transportation to and from affected area.
- Ensure smooth transportation links at all levels and to all nodal and support agencies.
- Coordinate the use of transportation resources to support the needs of emergency support forces requiring transport facility to perform their emergency response, recovery, and assistance missions.

ESF 13: Volunteers :

The Emergency Support Function (ESF) 13 indicated for 'Volunteers' will be led by the Youth Coordinator, Nehru Yuva Kendra. The supporting agencies for this function will be NCC, NYKS, Zilla Sainik Board, Blood Bank, Red Cross, NSS, Rotary Club, Lions Club, NGO's. and other organization. as decided by ESF 13 during preparation of their Standard Operational Procedures (SOP). The Primary Functions of the ESF 13 (Volunteers and Donations) will be:

Primary Functions:

- Encourage various voluntary agencies and organizations to depute the volunteers.
- Gather general youth mass to volunteer.
- Operation wise categorize the volunteers.
- Identify any specialized skills and area of interest among volunteers.
- For each team, reserve a back up force to replace the tired and engaged teams.
- During natural calamity (mass donation) collection of relief material & resource such as, food, clothes, medicines, essential items, cattle feed, and cattle medicines.
- Maintain a record of donations and its supply to the needy area

ESF 14: Public Works:

Restoration/reconstruction of Road is one of the important aspects during any disaster. Once road network is restored, relief and rehabilitation works becomes faster. On the above, it has been always noticed that the donating organizations proceed their relief

distribution activities till the accessible areas. The Emergency Support Function (ESF) 14 designated for 'Public Works' will be led by the Executive Engineer, PWD (Road). The supporting agencies for this function will be PWD (Road and Building), Electricity Board, Public Health Engineering Dept, Municipality etc and any relevant dept. as decided by ESF 14 during preparation of their Standard Operational Procedures (SOP). The Primary Functions of the ESF 14(Public Works) will be:

Primary Functions:

- Restore the road communication system
- Assess the damage for reconstruction of roadways
- Restore the infrastructure like health centers, school, important buildings,
- Initiate the reconstructions unrecoverable important infrastructures like health centers, school building, and important buildings.

ESF 15: Equipment support- Road Debris clearance

During any major disaster, road blockage occurs because of which, rescue, relief and emergency medical response is severely affected. Under such situation the district administration at first phase starts its road debris clearance works to clear the blockage in road but lacks in high graded equipment support and skilled manpower during the need. This delay in clearing the road blockage. Looking in to the above aspect, one separate Emergency Support Function for road debris clearance is thought for constituting to develop its well prepared Standard Operational Procedures. The Emergency Support Function (ESF) 15 designated for 'Equipment support- Road Debris clearance' will be led by Guwahati Municipal Corporation /PWD (R) supporting agencies for this function will be NCC, Scouts & Guides, Zilla Sainik Board, Divisional Forest Officer, NH Division PWD (Road), Fire Service, Civil Defence and Nearest Army Cantonment etc and any relevant dept. as decided by ESF 15 during preparation of their Standard Operational Procedures (SOP). The Primary Functions of the ESF 15 (Equipment support- Road Debris clearance) will be:

Primary Functions:

- Assess the gap-need of equipment support before any disaster.
- Emergency clearance of Debris to enable reconnaissance.
- Establishment of priority list of equipments which will be opened first.
- Coordinate and provide manpower and equipments for debris and road clearance
- Provide alternative routes, if main routes are affected
- Demolish unsafe buildings

**ESF 16: Public Information, Help lines and Awareness generation**

It is observed that, a chaotic situation due to rumour and panicky is created during any crisis. Under such circumstance a need for help lines and awareness generation is felt. Therefore a separate 'Emergency Support Function' titled as "Public Information, Help Lines and Awareness Generation" is suggested for constituting. The Emergency Support Function (ESF) 16 designated for 'Public Information, Help lines and Awareness generation' will be led by the District Public Relation Officer. and the supporting agency will be NGOs, Media (print/audio-visual), NSS, Scouts & Guides, Education Dept., etc and any relevant dept. as decided by ESF 16 during preparation of their Standard Operational Procedures (SOP). The Primary Functions of the ESF 16(Public Information, Help Lines and Awareness Generation) will be:

**Primary Functions:**

- Provide and collect reliable information on the status of the disaster and disaster victims for effective coordination of relief work at state level.
- Setting up of toll-free numbers for emergency information assistance.
- Process and disseminate information about the welfare of citizens of affected area
- Manage flow of information and warning dissemination.
- Establish help lines for providing, directing and coordinating logistical operations.

### **11.5.3.3 Standard operations procedure (SOP) for response in general flood and urban flood**

*Table 11-18: Designated Responses by different authority during flood at District level and Revenue Circle level*

<b>Response at District level</b>		
1.	On receipt of flood warning, DDMA will pass the information for taking necessary measures to:	Deputy Commissioner will direct ADC & CEO DDMA, Kamrup(M)
	<ul style="list-style-type: none"> <li>• Concerned Circle Officers</li> <li>• Superintendent of Police</li> <li>• Executive Engineer, WR department</li> <li>• Executive Engineer, PWD (R)</li> <li>• Station Officer, F&amp;ES &amp; IC of SDRF/NDRF stationed in the district.</li> <li>• Commissioner GMC, for immediate necessary response</li> <li>• Deputy Director, F&amp;C supplies</li> <li>• Jt. Director, Health Services</li> <li>• DVO to take necessary measures so that if necessary, assistance can be provided in short notice to the affected areas.</li> </ul>	

	<ul style="list-style-type: none"> <li>DIPRO, if requires giving public announcement for evacuating people from vulnerable areas.</li> </ul>	
2.	SP will instruct Senior Station officer, F&ES /SDRF to assist the Circle Officer in Rescue, Evacuation & relocation process.	Superintendent of Police(SP)
<b>Response at District level</b>		
3.	<ul style="list-style-type: none"> <li>Sr. Station Officer, F&amp;ES will mobilise teams of SDRF &amp; Boats available in their custody and coordinate with DDMA/ Circle officer for response.</li> </ul>	Sr. Station Officer, F&ES.
4.	<ul style="list-style-type: none"> <li>Executive Engineer will mobilize men and materials to strengthen embankments.</li> <li>For urban flood in Guwahati the executive engineer will mobilize officials and men to the pumping stations for immediate operation for dewatering of water.</li> <li>The designated officials will strat the pumping operation immediatly.</li> <li>Keep constant vigil on water levels in Brahmaputra,Bharalu, Mora bharalu, Bahini, basistha river &amp; take necessary measures like installing more pump sets wherever necessary, clearing of blockage if any etc. to keep the water level down so that water do not overtop and inundates the locality.</li> <li>Take immediate necessary measures to avert any breaches in embankments.</li> </ul>	Executive Engineer, WR Department (Civil & mechanical division)
5.	<ul style="list-style-type: none"> <li>Take adequate measures to ensure that the road communication is not disrupted; repair any breaches of roads for evacuation and supply of relief to the affected people.</li> </ul>	Executive Engineer, PWD (Roads)
6.	<ul style="list-style-type: none"> <li>On receipt of warning Commissioner, GMC will arrange men and material to be deputed in the affected areas.</li> <li>Installation of pumpsets and operators wherever required.</li> <li>Keep constant vigil on the the flood affected areas &amp; take temporary necessary measures to clear blocked secondary and tertiary darins in those areas.</li> </ul>	Commissioner, GMC
<b>Response at District level</b>		
	<ul style="list-style-type: none"> <li>Supply of drinking water to the affected people, arrangement of alternative communication for transportation and evacuation.</li> </ul>	

7.	<ul style="list-style-type: none"> <li>Jt. Director, Health services on receipt of information will initiate to mobilize medical response team, ambulances &amp; alert all govt. hospitals in the area likely to be affected.</li> <li>He will also direct SDMO or I/C of the PHC of the concerned area to form a team of doctors equipped with necessary medical equipments and move to the affected places or relief camp/centre as required by the Circle Officer.</li> </ul>	Jt. Director, health Services.
8.	<ul style="list-style-type: none"> <li>Take periodic report of the situation &amp; instruct Circle Officers, Jt Director, Health Services, Executive Engineer PWD (R), PHE, WR, GMC, Irrigation, Police, F&amp;ES to take necessary measures as required for dealing with the situation.</li> </ul>	Deputy Commissioner, Kamrup(M)
9.	<ul style="list-style-type: none"> <li>Deputy Commissioner will also inform state HQ about the prevailing situation &amp; action taken.</li> </ul>	Deputy Commssioner
<b>Response at Revenue Circle</b>		
10.	<ul style="list-style-type: none"> <li>On receipt of warning, mobilize the Lot Mondals, Gaon Burha, SDRF and other agencies &amp; resources available under Circle Officer's jurisdiction.</li> </ul>	Circle Officers of the concerned Rev. Circle
11.	<ul style="list-style-type: none"> <li>Go to the immediate location immediately &amp; inform the villagers on the probability of any flood event and ask them to take necessary precautionary measures.</li> </ul>	Lot Mondal & Gaon Burha
12.	<ul style="list-style-type: none"> <li>In case of probability of high intensity flood, evacuation of people from vulnerable areas to pre identified safe locations &amp; preposition of quick response team/SDRF/NDRF/Police force</li> </ul>	Circle Officers of the concerned Rev. Circle
<b>Response at Revenue Circle</b>		
13.	<ul style="list-style-type: none"> <li>Keep DC informed on hourly basis about the situation on the ground level and may request for additional resources of man material &amp; machines if required from DC.</li> </ul>	Circle Officers of the concerned Rev. Circle
14.	<p>Inform-</p> <ul style="list-style-type: none"> <li>Concerned BDOs, so that BDOs can inform PRI representatives for appropriate action.</li> <li>Ward councellors and ward members for appropriate action.</li> </ul>	Circle Officers of the concerned Rev. Circle
15.	Open relief camps, if required and give requisition for GR to DC	Revenue Circle Officer
16.	Arrangement for distribution of relief	Revenue Circle Officer

**11.5.3.4 Response Plan for Earthquakes**

The Response to Earthquakes where the level of disaster is L2 or L3 will require the response mechanism to be in line with the Incident Response System which is detailed in Chapter VI section 6.2. As per the IRS guideline, the Incident Response team will be activated and the Response Plan for the first 72 hours is given below.

*Table 11-19: Response Plan for the first 72 hours for earthquakes*

Sl. No.	Task	Responsibility
<b>Time Frame: 0-24 Hours</b>		
1.	Report the occurrence of earthquake with details regarding magnitude, epicentre and related details from agencies like IMD, NEIST and other sources. If large scale damages are likely to occur, SEOC to inform all concerned officers of IRT.	SEOC
2.	If it is a L2/L3 disaster, the State level Incident Response team (IRT) shall be activated immediately without any formal notice and the team to assemble at the ASDMA Office which will function as the SEOC. Simultaneously in the districts the District level IRT will be activated and shall meet at the Conference Room of the DC's office which will now function as the DEOC.	State level IRT/District level IRT
3.	IRT to be activated by a responsible officer. Scale of activation of IRT shall be decided by the RO/IC in SEOC.	Responsible Officer
4.	All nodal officers of the line departments will man the desks both at the SEOC and DEOC levels with their departmental response plans and resource inventories	All line departments
5.	Information from the affected sites shall be collected for briefing the IRT and chalking out strategy for response	Incident Commander/ Planning Section Chief



6.	In case of communication link failures, alternate communication linkages with the districts shall be established through satellite phones, HF/VHF sets, HAM Radios and VSATs.	Communication unit, ASDMA and Police communication
8.	Responding agencies shall mobilize their resources for responding to the event. They are to send their resources to the Staging Area which will be activated by the Staging Manager. Record of entry of the resources and their deployment shall be maintained.	All Responding Departments and Staging Area Manager
9.	Mobilize SAR Teams and search & rescue equipment and machinery to affected areas	Operations Section Chief both at State and District level in consultation with Director F&ES(State) and Senior Station Fire Officer ( District), NDRF (if stationed nearby)
10.	Mobilize Medical First Response Teams to affected areas	State: Director, Health & Family Welfare, Superintendent Medical College District: Superintendent Medical College/ Civil Hospitals/Joint Director Health Services
11.	Set up field hospitals near the affected areas and arrange to shift injured persons to field Hospitals	Director, Health & family Welfare (State)/ Superintendent Medical College or Civil Hospitals/Joint Director Health Services (District)
12.	Health Institutions (Government and Private Hospitals) to be activated for receiving patients.	Director, Health & family Welfare (State)/ Superintendent Medical College or Civil Hospitals/Joint Director Health Services (District)

13.	Make suitable transportation arrangements for the mobilization of quick response teams to the affected areas	Transport Branch under Operation Section
14.	Provide security in the affected areas and maintain the law and order situation	Police
15.	Request for the services of NDRF and Armed forces, if required through designated representative	Incident Commander
16.	Assess the conditions of road, rail and air communication link for quick mobilization of Emergency Teams and resources to affected areas and take follow up actions	Planning Section Chief
17.	Information and Publicity to establish media management / information cell for public information, guidance and rumour control	Information Officer
18.	Mobilize relief materials i.e., tents, food materials, water, essential medicines, blankets and other items to the affected districts and Revenue Circles	All concerned departments
19.	Arrange to shift evacuated persons to temporary shelters and ensure provision of food, water facilities, blankets, and storage of relief materials	Revenue Circle Officer
20.	Arrange road, rail and air transport at State / District headquarters for dispatch of relief materials to the affected areas	Transport branch under Operations Section
21.	Establish relief coordination centres at the airport, railway station and other important places for the arrival of Search & Rescue and Medical Teams coming for humanitarian aid	Logistics Section
<b>Time Frame: 0-48 Hours</b>		
22.	Arrange information centre at shelter site for maintaining records of victims and to provide guidance to relatives, NGOs and others	Information Officer
23.	Arrange for complaints regarding missing persons and initiate search in shelters, hospitals and police records	Team under Information Officer
24.	Arrange for quick assessments of safe buildings for residents to enter	Assessment teams from PWD (B)/Engineering Colleges and others

25.	Arrange for receiving humanitarian aid teams	Logistics Section
26.	Arrange for disposal of dead bodies	Municipalities
<b>Time Frame: 0-72 Hours</b>		
27.	Arrange for disposal of unidentified and unclaimed dead bodies	Police/Magistrates/Municipalities
28.	Activate short and interim relief measures	Relief Branch

#### **11.5.4 Relief Plan**

##### **11.5.4.1 During the Disaster**

- Disseminate the warning of disaster from DDR&IC to all concerned destination in single attempt by using mass sms, announcement through radio, through mass voice mail and ask the people who are likely to be affected, to take shelter in safer places.
- Immediate deploy the forces to clear the route of search & rescue and also to clear the traffic from the route of rescue.
- Command to the forces, NGO, SHG & volunteers to rush immediately to the affected area for search and rescue with all pre-enlisted tools and equipments for disaster.
- During the time of occurrence of disaster, the Nodal Officer shall liaise with all Head of office, Public Leaders and others organizations and initiate prompt measures to prevent loss of human lives and property damage.
- The Nodal Officer shall initiate immediate necessary measure for evacuations, organize Search and Rescue teams with consultation with the concerned Member which have been entrusted to this work.
- If necessary, the Nodal Officer will initiate setting up of Relief Camp for the affected people in a safer place and ensure proper supply of safe drinking water, electricity, medical facilities and rations etc. with the help of concerned departments to the relief camp.

##### **11.5.4.2 Post Disaster:**

- A Post- disaster evaluation should be done after the withdrawal of relief and rehabilitation activities in order to assess
- The nature of state intervention and support,
- Suitability of the organizational structure,
- Institutional Arrangements,
- Adequacy of Operating Procedures,

- Monitoring mechanism,
- Information tools,
- Equipments,
- Communication System, etc.

The impact studies on the aforesaid operations for long term preventive and mitigation efforts are to be undertaken. Evaluation exercises may be undertaken to understand the perceptions about disaster response in terms of

- Adequacy of training
- Alert and warning system,
- Control Room functions,
- Communication plans,
- Security,
- Containment,
- Recovery procedures,
- Monitoring.

**11.5.4.3 Relief and Rehabilitation Plan for Flood***Table 11-20: Relief and Rehabilitation Plan for Flood*

Sl. No.	Floods	Deputy Commissioner/ DDMA
1	Pre-Flood	<ul style="list-style-type: none"> <li>Maximum number of relief centres likely to be set up</li> <li>Facilities to be available at each centre</li> <li>Maximum likely number of relief parties</li> <li>The way individuals and voluntary organizations are to be associated with the relief teams</li> <li>The way Panchayats will be associated with relief operations. Divide the district into compact zones each comprising a group of villages falling under both 'very vulnerable' and 'vulnerable' areas as classified in GDMP and each such zone shall be serially numbered. Select sites for evacuation centres and relief centres in safe areas. The site for sheltering livestock may be decided in consultation with the district A. H. &amp; Veterinary officer. In selecting sites, preference shall be given to high lands, schools, marketplaces, and places not likely to be inundated.</li> <li>Make a rough estimate of requirements</li> <li>Prepare a sub-division wise list of officers and staff available for deployment of relief duty as and when called for.</li> <li>A list of jeeps, buses, trucks and other vehicles for requisition in case of necessity, in consultation with the D.T.O;</li> </ul>
2	During Flood	<ul style="list-style-type: none"> <li>DDMA will conduct weekly meeting to review flood management during the flood season. On receipt of flood warning D.C will: take action as per Standard Operating Procedure (SOP) prepared by the State. On occurrence of Flood the DC will: visit the places of occurrence, ascertain the nature and extent of flood and make prompt operational decisions. DC will arrange proper distribution of relief articles received as donation in kind among the deserving affected people through the official and non-official agencies</li> <li>DC will arrange for taking care of the infirm, destitute, orphans, children, and expectant/nursing mothers in the relief centres through the assistance of the distribution social welfare officer.</li> </ul>
3	Post Flood	<ul style="list-style-type: none"> <li>DC will collect agricultural statistics from the revenue staff and the district agricultural officer about areas under crops affected by flood, damage to crops and the number of cultivators involved</li> <li>After the flood recedes, a report on losses and damages of each area needs to be submitted to the Government in the Revenue &amp; Disaster Management Department in the form as given in Appendix X of Assam Disaster</li> <li>Generally, full pictures as to the duration of relief measures will emerge as soon as the waters have subsided. In declaring closures of relief operation, he will take the approval of the divisional commissioner and inform all concerned.</li> </ul>

### **11.5.5 Recovery Plan**

In the unfortunate event of a natural calamity like a cyclone or flood its important focus on the methods and activities to restore lifeline support physical infrastructure like adequate water supply, power and communication networks, accessibility to the site. These must be the described in the disaster management plan- relief & recovery part. In the river side of the Guwahati city the communities are depended on the specific infrastructure for their livelihood, and these should be identified and methods to restore them in short/medium/long term have to be identified and respective funding reequipments have to be made available and followed by speedy decision-making process.

In the District, the Nodal agency plays direct and active role in relief. The Deputy Commissioner office either directly or through assistance will inform to the nearest police stations, WT stations, administrative officers and nodal agencies at Circle, Sub-Divisional and Dist. HQ by quickest means. For timely assistance to the people affected by natural disasters it is necessary to have correct assessment of extend of damage to crops, public & private properties and loss of human lives and livestock. The emergency relief measures and relief measures in the aftermath of a disaster is generally carried out in compliance with Calamity Relief Fund Norms by Deputy Commissioner.

The task force is responsible for collecting the extend of the damages with respect to number of houses damaged, loss of human lives, number of person injured, information about individual families, their income, property and assets. The zonal officer has to prepare a report on the same to be sent to the Deputy Commissioner. The mentioned assessment is to be carried out on priority basis so that the Nodal Department in the district Region which is the Department of Disaster Management can extend relief assistance in time in order to mitigate the effect of the natural disaster.



## **11.5.6 Department Roles and Responsibilities**

### **11.5.6.1 *Administrative Preparedness for Different Disasters***

The following steps have been taken as a part of administrative preparedness to combat any eventualities during and immediately after the disaster:

- Control Rooms (DEOC) are functioning round the clock in DC's Office, Offices of the Jt. Dir of Health Services, DA&VO, District Agriculture, PWD ( R), PWD ( B) All Executive Engineers of Irrigation, R&B (PWD), CWC, PHE,
- Senior Level Officers from different departments will be assigned charges for all the flood/cyclone zones along with the BDOs of respective blocks.
- Telephone Numbers have been made available to the Regional Meteorological Centre, Guwahati to intimate about the adverse weather
- SDO Telegraphs / Telephones have been requested to keep the lines in order at the time of calamity
- Daily report of rainfall is being obtained from the DEOC.
- The Executive Engineers E & D have been intimated to report Gauge reading of the rivers, daily during flood and to keep drainage clean & repair all weak points/ breaches caused in the last flood and complete the left out work before the onset of monsoon, keep a close watch on the embankments passing through the habitations, remain alert with men and materials to face any eventualities
- Executive Engineer, PHE has been directed to repair / replace the defunct tube wells on war footing basis before the rainy season
- The Superintendent of Police has been intimated to monitor the installation of Police Wireless Stations and make arrangements for army assistance.
- VHF's to be installed at DEOC/ Circle Offices.
- Satellite phone (to be installed at DEOC)
- ADM (Relief) have been directed by the Deputy Commissioner and District Magistrate to store adequate foodstuff at interior, vulnerable strategic and key areas for immediate relief.
- NGOs have been identified block wise and task force been formed in collaboration with the district administration to carry out relief operation, rescue and evacuation, etc.
- DAO has been intimated to supply HYV paddy seeds to the blocks as a part of agricultural measure.
- Jt. Dir of Health Services has arranged Medical Relief Camps and doctors have been deployed for the purpose and the Jt. Dir of Health Services has been directed to keep the mobile medical team ready for the purpose.
- DA&VO, indent of different vaccines has been taken to protect animals against contagious diseases, medicines supplied to the field functionaries for routine treatment as part of veterinary measures.

- Inspector of Schools and PWD (B) Magazine Department will remain in charge of safety of relief Shelters (Used in Flood, Cyclone & other calamity)
- PWD (R) Officer will look into the repairs major roads, bridges, concrete steel work and make other necessary arrangements
- NGOs / CBOs have been organized by the respective BDOs as relief parties
- Review of pre-flood/cyclone arrangements have been carried out and the contingency plan for flood and cyclone prepared by all the BDOs.

#### **11.5.6.2      *Disaster Specific Capability Analysis with the Human Resources and Skills***

All the line departments such as Health, Veterinary, Irrigation, Police, Revenue, Electrical, PWD (B & R), CWC, ULBs etc. are instructed to stay prepared with the equipments and manpower before the specified disaster seasons. They will give a list of their resources and requirements to the Deputy Commissioner well in advance so that proper preparatory measures will be at place. The NCC, NSS and Paramilitary Forces will have to prepare a list of task force for the rescue, evacuation, and relief operation. They will be provided with a relief kit each and a training manual. Training should be conducted at the District, Block, GP and village levels to ensure that the awareness for disaster mitigation is built up among the communities. Mock drill should be conducted in anticipation of disasters to enhance the skills of the task force.

#### **11.5.6.3      *Police department***

To achieve smooth and orderly evacuation of human lives and properties the district Police Department has to play vital role. The Police Department will keep close liaison with Deputy Commissioner/Addl. Deputy Commissioner (Disaster Management) and the District Emergency Operation Centre (DEOC). The Superintendent of Police will chalk out action plan forming different zones and sectors with Police Zonal & Sector Officers for smooth conduct of rescue and relief operation. The Zonal and Sector Police Officer will keep close liaison with the District Headquarter as well as concerned departments like Fire Service, Civil Defence, Health, Army & Paramilitary, Air Force, Transport, and ensure the following tasks.

#### ***Pre-Disaster***

##### ***Preparedness and Dissemination of Warning***

- Reception of Warning from the DEOC or other Source
- Communication establishment with District and Block Control rooms and departmental offices within the division.

- Alerting the Police force for deployment at the time of calamity
- To issue directive to police field functionaries to co-operate with Revenue Personnel in management of Relief operation & Patrolling

### **During Disaster**

#### ***Rescue and Evacuation:***

- Involvement of Specialized Search & Rescue Team.
- Clearance of roads and other means of transportation
- Traffic management and patrolling of all highways and other access roads to disaster sites
- Making sure that discipline is maintained
- Assistance to district authorities for taking necessary action against hoarders, black marketers and those found manipulating relief material
- Co-ordination with fire personnel. Provision of security in transit camps/feeding centers/relief camps/cattle camps/cooperative food stores and distribution centers safeguarding of belongings of evacuees

#### ***Distribution of Relief***

- Maintaining laws and order at the Shelters and the relief camps
- Coordination with military service personnel in the area
- Deploying officers/ police personnel to record death cases Assisting the community in organizing emergency transport
- Assisting the District officials/NGOs in distribution of relief materials.
- Providing escorts in transit of relief materials to the relief camps/affected areas

#### ***Patrolling***

- N.H, Bridges, Public Institutions, go downs etc

### **Post- Disaster**

#### ***Short term Measures:***

- FIR of the disasters, the damages and the death cases.
- Assisting in collection of damage statistics of private properties.
- Maintaining law and order

#### ***Long Term Measures:***

- Close Coordination with district administration and local/external NGOs in reconstruction and rehabilitation process
- Assisting the District authority whenever the need arises
- Periodical visits to the affected areas to ensure law and order

**11.5.6.4 Fire & Emergency Service**

Fire (natural as well as manmade) is one of the major disasters that causes loss of human lives and property. Sometimes not because of earthquake, but because of fire people lose their lives.

- Ensure that proper firefighting precautions has been taken while issuing permission for construction of buildings
- Make sure that smoke detectors/ firefighting equipment are installed in all important places like Govt. offices/ schools/ colleges/ cinema halls/ industrial units and other installations where the people gather in large number. Also train up employees about the techniques of using fire fighters
- Make sure that sufficient number of fire tenders with all Equipments in working condition are available round the clock
- Train up/ Motivate people how to use fire fighters and its advantages
- Carry out Fire Mock Drill in schools/ public places/ apartments etc. to raise public awareness

**11.5.6.5 Assam State Disaster Response Force Services****Pre-Disaster**

- Making sure that everything stays at place in the control room.
- Seeing to it that the GDMP and the contingency plan for flood/cyclone reach all the line departments.
- Receiving the Warning from SRC and crosschecking them with IMD and in websites for authenticity
- Disseminating the warning to the Circle & block offices and asking them to disseminate further to reach each and every household.
- Deploying the staff of the control room for round the clock alertness.
- Making sure that all the shelters receive enough water and food stocks in advance
- Establishing contact with all the line depts.
- Over phone, email, wireless, sat phone and VHF
- Procuring all the required resources from all the possible sources.
- Regularly updating the information received from the blocks

**During-Disaster**

- Coordinating with all the line departments for rescue and evacuation.
- Checking the stocks with the DEOC and asking for more if needed.
- Distributing the relief materials to all the places.
- Checking every bit of receipt and dispatch of relief items
- Establishing round the clock contact with all the depts., C.Os and Sr.BDOs / BDOs and with the shelters

**Post- Disaster**

- Receiving the list of beneficiaries from different BDMC and GPDMCCross checking the list of beneficiaries to avoid fabrication

#### **11.5.6.6 Civil Defence & Home Guard**

For effective operation, works of various services, personnel must have proper training and discipline with a view to achieve this intensive training with special reference to the earthquake disaster should be arranged to train up the volunteers and other related personnel as well as the public. The efficiency in performance of the various services depends highly upon the amount of training imparted to them. In Civil Defence towns, training with special reference to earthquake are already introduced in educational institutions. It is suggested to conduct some exercises by Civil Defence department, in the rural areas to enlighten the public and students for their action and part played in a disaster. Civil Defence Department will keep a register of trained volunteers so that their services can be utilized in disaster relief operation in respective service. The Deputy Controller of Civil Defence, entire GMPA will properly maintain the equipments necessary for conducting rescue operation to extricate the casualties trap from under debries. He will also ascertain the resources of manpower and materials available with the local Agencies like Home Guard, and other Local voluntary organization such as Indian Red Cross Societies, N.C.C., and Scouts & Guides Etc. Civil Defence and Home Guard, Guwahati city will have to prepare a separate contingency plan for this purpose. They need to spare sufficient numbers of Home Guards for emergency operations as and when called for.

#### **11.5.6.7 Health Department**

The Health Department will make necessary arrangements for blood banks and other lifesaving emergency services. All Civil Hospitals and The Assam Medical College should be on alert. One senior Doctor for emergency duty should be detailed on a round-the-clock basis in the Casualty Ward in these Hospitals. Ambulances with life savings drugs need to be kept in readiness. An inventory of all private ambulances should be prepared along with the names of the drivers and their contact phone numbers.

### **Pre-Disaster**

#### ***Preparedness and Warning Dissemination***

- Stock pilling of Life saving drugs/ORS packets/Halogen tablets on receipt of warning from the D.C



- Transmission of messages to all PHCs to stock medicines and keep the medical staff ready
- Disease surveillance and transmission of reports to the higher authorities on a daily basis.
- Vaccination
- To obtain and transmit information on natural calamities from the DEOC
- Advance immunization programme in the flood/Cyclone prone areas.
- Ensuring distribution of areas of operation among the mobile team.
- Pre-distribution of basic medicines to the people who are likely to be affected
- Shifting the patients who are in critical situation to the District Hospital
- Awareness messages to stop the outbreak of epidemics
- Conducting mock drills

### **During Disaster**

#### ***Rescue and Evacuation***

- Coordination with Specialized Search & Rescue Team
- Constitute mobile teams and visit the worst affected areas.
- Dis-infection of Drinking water sources.
- Opening of site operation camps
- Regular Health Check up at Shelter camp/Cyclone shelter & affected areas
- Assigning responsibilities to the CM& HOs/ SDM& HOs for close monitoring of Health camps.

### **Post- Disaster**

#### ***Restoration and Rehabilitation***

- Organization of Health Camps,
- Deploying mobile fully equipped and manned Medical vans
- Close monitoring of Health camps.
- Ensuring adequate quantities of medicine/disinfectants
- Making sure that there is no out break of water borne diseases/Malnutrition
- Co-ordination with the District
- Rehabilitation Committees, other line departments, NGOs /ICDS projects, village committee, PHE, etc.

#### **11.5.6.8      *Public Works Department***

Structural safety of all existing RCC, Steel and masonry buildings needs to be assessed with regards to its safety against potential hazards like earthquake, floods, fires and accidents. The PWD (Bldg.) division has to prepare and provide checklist for regulatory and development authorities.



***Duties to be performed in normal time***

- Ensure that the roadside materials are stacked in proper places so that they are not washed away.
- The passage of all cross drains (bridges and culverts) is clear, free from obstruction to allow easy flow of flood water.
- Repairing of damaged culverts and bridges wherever necessary.
- Desiltation and cleaning of the PWD Drains
- Ensure that Equipments, vehicles like bulldozer, trucks road rollers and keep ready for use.
- Arrange reserve stock of tools and plants and other stores at scales prescribed by the Chief Engineer,
- Material for constructing temporary bridges and camps for PWD workers are available
- Assess and prepare list of staffs of different categories for duties and make necessary arrangement

***Duties to be performed after receiving 1st warning***

- On receipt of flood warning the Executive Engineer will
- Keep constant and continuous contacts with the Deputy Commissioner/circle officers.
- On occurrence of flood, immediately visit the flood affected areas.
- Assess requirement and deploy staff for keeping round the clock vigil of the roads, bridges etc.
- Report of the road submergence to the Deputy Commissioner, immediately after the occurrence indicating concisely the location and extent of submergence.
- Render technical assistance as may be required by the D.C. in constructing temporary huts in relief camps and in other test relief works.

***Duties to be performed after the disaster***

- Restore tools and plants.
- Repair/replace damage tools and plants.
- Take steps for repairs to damaged roads, culverts, bridges and buildings and other structures borne in the books of PWD.
- Prepare plan and estimates for immediate restoration of damaged infrastructures and place it before DDMA for forwarding it to government.

**11.5.6.9      *Public Health Engineering Department***

Water borne diseases are one of the major reasons of increasing the number of deaths after any disaster. Providing purified water to the affected people is a challenge. The

PHE department plays a vital role in this regard. Checklists for this department are as follows

- The PHE department, Guwahati will have to keep sufficient stock of water purification materials like bleaching powder, alum and lime etc. for carrying to the area where necessary and depute their field staff whenever disaster situation claims.
- The PHE Engineer staff will keep in constant touch with the Zonal Officers during and after the disaster.
- Ensure safe hygiene through Total Sanitation Campaign (TSC). Motivate the people to exercise proper disinfections and hygiene practices for drinking water and taking food.
- Undertake risk assessment and management of ground water resources in emergency situations.

#### **11.5.6.10     *Water Resources Department***

##### ***Duties to be performed in normal time***

- The branches to embankments, to be checked and repaired.
- The Embankments should be strengthened.
- Clearing, widening digging of the natural channels like Bharalu, Mora Bharalu, Bahini and Basistha.
- The obstruction in the natural channels, if any should be got removed immediately for enabling free flow of water.
- The sluice gates of the channels and waterbodies are to be checked and satisfied that they are in good condition.
- The instruments and materials etc. required attending to immediate repairs breach of embankment etc. should be stacked at places where they may be required locating such places early.
- The Channels and drains should be free from obstruction and they should be made available for free discharge of drain water.
- Installation of pump sets in strategic location and deployment of staff for operation of the pumps for dewatering of logged water.

##### ***Duties to be performed after receiving 1st warning***

- 1<sup>st</sup> warning should be communicated to all the subordinate staff and employees.
- They should be alerted to check whether the Channels and drains are in proper condition to allow free flow of water.
- Field staff should be placed in the field and be ready for response.
- As soon as the river is within one metre of the danger level start vigorous patrolling the reach of embankment /dykes and ensures any leakage, seepage etc. is promptly attended to.

- On occurrence of flood the department will examine the physical conditions of the dikes and ensure any leakage, seepage etc are promptly attended to.
- Assist DC in flood operation by sparing personnel equipment, vehicle, pump sets etc. available

***Duties to be performed after the disaster***

- Damages due to Flood to embankments roads etc. should be assessed and reported to C.Os & SR. BDOs/ BDOs, EO concerned immediately.
- Digging of link drains and other drains to drain outstanding flood water.
- Construction and repairs to ring and other Abadi protection bunds
- Repair to and deepening of existing drain to eliminate possibility of future floods.

**11.5.6.11      *Irrigation Department***

The Executive Engineer is to keep sufficient nos. of portable pump sets ready on 24x7 hourly basis. He will arrange sufficient manpower and assign duties likewise.

***Duties to be performed in normal time***

- The branches to canal drain bandha to be closed.
- The Embankments should be Strengthened.
- It should be checked whether the passage bridge and channels are in good condition.
- The obstruction in the canals if any should be got removed immediately to be enabling free flow of water.
- The bocks and shutters of the canals are to be checked and satisfied that they are in good condition.
- The instruments and materials etc. required attending to immediate repairs breach of closures etc. should be stacked at places where they may be required locating such places early. Navigation in the canal should be stopped. Water supply into canals should be out off by closing the sluices. The canals and drains should be free from constructing and they should be made available for free discharge of drain water

***Duties to be performed after receiving 1st warning***

- 1st warning should be communicated to all the subordinate staff And employees.
- They should be alerted to check whether the canals and drains are in proper condition to allow free flow of water.
- The stations tour should take their duty places and be readily available.
- Keep sufficient no. Of vehicles for one by the staff on Flood duty. Lunches to be requisitioned.

***Duties to be performed after the disaster***

- Damages due to Hazards to Govt. properties lives of man and cattle etc. should be assessed and reported to C.Os & SR. BDOs/ BDOs, EO concerned immediately

#### **11.5.6.12 Transport Department**

##### ***Duties to be performed in normal time:***

- List of vehicles running condition to be requisitioned kept ready.
- The MVI/Asst. MVI will report before A.D.M. (Relief)
- The Asst. Engineer & Jr. Engineers will remain alert.
- Based on the experience on the previous flood sufficient no. of trucks should be procured and kept in District headquarters.
- To contact all Block Control Room and D.C Office.

##### ***Duties to be performed after receiving 1st warning***

- Availability of petrol, oils should be ensured.
- The requisition orders on owners of vehicles for flood duty.
- Soon after receipt of 1st warning all the public call officers to be informed to instruct the village Goanborah/ Headman/ Postmaster/ Warning group for dissemination of warning in the villages.
- Provision of vehicles.

##### ***Duties to be performed after the disaster***

- Electricity Dept. for restoration.
- Roads and buildings for clearance.
- Restoration of Telephone lines to control room to Collector, Hospital, fire station S.P. and other offices as per the list appended.

#### **11.5.6.13 Food and Civil Supplies Department**

They are responsible for proper and quick distribution of Civil Supplies at the time need. They will ensure procurement of essential commodities (controlled & noncontrolled) and maintain buffer stock of sufficient quantities to be released during necessity. They are also to issue instructions to the Roller Flour Mills to keep rolling stock of wheat bran/ rice barn and send regularly a list displaying availability of these 28 items. The F&CS department has to keep constant vigil so that traders do not take advantage of the situation creating artificial scarcity of commodities and inflate prices.

#### **11.5.6.14 Veterinary Department:**

Disaster causes death and injury to animals also. The veterinary Department with the assistance of NGOs/volunteers working in this line will organize in such a way that can expeditiously take steps for rescue of seriously injured animals and disposal of dead

animals also. District Veterinary Officer will assess requirement of equipment's and other veterinary staff, medicines vaccines disinfectants etc. and prepare an Action Plan to combat the possibilities of injuries and epidemics etc. They will conduct assessment of damage and economic loss due to disasters within the sector.

#### Pre Disaster

- Adequate skilled manpower First aid facility
- Identification of safer place (like open space/ high land)
- Network of communication with skilled personnel
- Immunization against any outbreak of prevalent diseases.
- Train Crass Disposal Team at grass root levels

#### During Disasters

- He should communicate the warning of flood received by him immediately to the sub-ordinate officers
- Deployment of skilled personnel in the affected areas and work with local
- Disaster Management Team. Rescue and rehabilitation of affected animals to safer places
- Arrangement of feed and fodder.
- Rendering first aid where necessary

#### Post- Disaster

- To arrange Veterinary Health Care camps in the affected areas.
- Collection of damage statistics and inform D.C
- Crosschecking the list of beneficiaries to avoid fabrication (While assessment include DMC members)

#### **11.5.6.15     Agriculture Department**

During flood/draught, loss to seasonal crops is considerable. The Agriculture Department is entrusted with provide necessary technical support to the district administration.

- Establish coordination in implementing and providing technological know-how on drought management to the farming community through agricultural extension services
- Continue educating farmers on soil and water conservation technologies through implementation of watershed projects and know-how of drought resistant crops
- The Agriculture Department will make an assessment of acreage under crops and number of cultivators to be affected in each of the areas.
- They need to assess the requirement of seeds, seedlings, manures etc. for grants, tools and plants for emergency relief works



- They have to advice on the suitable cropping pattern. Arrange for spraying of pesticides wherever necessary.
- Make sufficient stock of seeds, manures, implements etc. and make arrangements for raising seedlings. 29
- Arrange distribution of agricultural inputs in consultation with the district administration.
- Render technical support to the needy cultivators for salvage and protection of surviving crops
- Repair the damaged tools and plants

#### **11.5.6.16 Social Welfare Department**

During any disaster the weakest & neglected section of the community viz. women, children, senior citizens, physically handicapped suffer the most. It is the responsibility of our society to protect them.

- The Social Welfare Department has to make arrangement for mobile maternity and child welfare centres wherever necessary
- Access the requirement of baby food etc. and arrange them. They have to extend help for taking care of orphan & mother, and the sick
- Maintain in directory of all social welfare organizations located in the district and made it available to the DDMA
- Alert personnel for floods on receipt of warning and kept constant touch with the district administration All heads of the Departments/Offices will keep constant touch with the District Officials/Disaster Emergency Operation Centre at GMDA CEO's Office. Every department will have to prepare separate Action Plans showing the Standard Operating Procedures (SOPs) to be adopted on emergency and Resource Inventory (human & material) and made it available with the DDMA, Kamrup Metro.

#### **11.5.6.17 Guwahati Municipal Corporation**

##### ***Duties to be performed in normal time***

- Ensure clearing and desiltation of secondary and tertiary drains
- Checking and repairing of pumpsets, and other equipments and keep they ready for use during flood.
- Keep the manpower, officers ready to tackle any eventuality
- Keep stock of disinfectants, etc. for spraying in affected areas.
- Assess and prepare list of staffs of different categories for duties and make necessary arrangement.

##### ***Duties to be performed after receiving 1st warning***

- During flood installation of pumpsets in the affected areas for dewatering.
- Arrangement for alternative transportation for affected people.
- Help administration in relief operation.
- Supply of drinking water to the affected people.



***Duties to be performed after the disaster***

- Assessment of damage of roads, drains due to flood.
- Clearing of secondary and tertiary drains.
- Clearing of garbages silt etc form drains and roads.
- Spraying of disinfectants in the affected areas.
- Providing purified drinking water etc.
- Restoration and repair of roads and drains damaged due to flood.

**11.5.6.18 Deputy Commissioner / District Magistrate****Pre- disaster:*****Preparedness before the disaster:***

- Reviewing and analysing the calamity situation in the district over the next one-year through a meeting at the District level involving all the departments of the district as well as block and Village levels and the locally active NGOs/CBOs
- Identifying disaster prone zones and strategies to stay prepared for the worst.
- Ensure IEC through Emergency section/C.O/ BDO's /NGO's: Movies/Street plays/ Workshops / Wallings/ Painting. Reviewing the DEOC and making it functional Making the DEOC well equipped and depute senior officers from time to time to review the receipt of information and dissemination.
- Calling a meeting for NGO/CBO co-ordination. And discuss issues such as Capacity assessment of different NGOs/CBOs and ask them to adopt certain vulnerable areas to avoid overlapping and duplicity. Preparing a checklist (containing the dos and don'ts) and pass that on to the NGOs/CBOs
- Ensuring/installing communication system to the inaccessible villages.
- Checking stock of the Public distribution system and arrangement of the temporary go downs.
- Checking the Resources with other department such as Police, Fire, Civil Defense and of NSS/NCC/NYKS.
- Preparing a list Power Boats already deployed and/or to be deployed on hire during crisis.
- Keeping stock of road cleaning equipments and vehicles for relief operation.
- Assigning specific duties to different officers/Sr. Officers at Headquarters.
- Staying in constant touch with other line departments.
- Ensuring proper functioning of warning systems & communication systems.
- Ensuring Mock drill of the rescue and relief teams.
- Preparing a map showing the location of temporary shelter camps and cyclone shelters with accessibility
- Identifying flood/cyclone Shelter/Temporary shelter in high elevated places and arrangement of tents etc
- Identifying and mapping of Disaster (of all kinds) Prone areas
- Ensuring formation of village level Disaster Management Committee through Block Development officers

***Dissemination of Warning:***

- Receiving Warning from reliable sources and crosschecking them for authenticity.
- Disseminating warning to District level officials /Block /PRIs & coordination with others
- Keeping the Control Room active round the clock.
- Distributing duties to the district level officials, Circle officers and Sr. BDOs/BDOs.
- Arranging vehicles and public address systems for information dissemination.
- Establishing coordination with the NGOs/CBOs and the village communities and assigning them duties.
- Issuing warning to fisherman through Circle officers/Fishery Department well in advance
- Asking the people in the vulnerable areas to move to the shelters and to move their domesticated animals to safer places and to cooperate with the volunteers and other officials engaged in similar activities

**During Disaster****Search, Rescue and Evacuation:**

- To co-ordinate with Civil defense, NGOs/CBOs. Zilla Sainik Board/Police for support.
- Arrangement & Deployment of boats/vehicles etc. for evacuation
- Evacuating people from marooned areas and administer emergent relief.
- Organizing trained task force members and deputing to be marooned & Cut-off areas for evacuation.
- Deployment of police for maintaining discipline and peace keeping during evacuation Mobilizing people to move to flood/cyclone shelters.
- Deployment of Power Boat/Country Boat (Govt./Private) for evacuation wherever necessary. Deployment of Police/Fire Brigade for search and rescue.
- Co-ordination with the NCC/NSS/Civil Defense/Zilla Sainik Board etc. for rescue operation Ensuring proper utilization of the rescue materials
- Providing Rescue kits at the affected areas

**Distribution of Relief Materials:**

- Keeping a record of the affected area and people so as to account for the relief materials needed.
- Procurement and transportation of relief materials to affected areas
- Arrangement of free kitchen in the shelter camps & affected areas and assigning the responsibilities to officials for proper distribution Coordinating with the NGOs/CBOs
- Encouraging other voluntary organizations from outside for rescue and relief operation.
- Distribution of basic medicines and disinfectants to prevent epidemic

- Ensuring Health care activities by the CDMO in the shelter camps & through mobile Units/Temporary
- Health in regular intervals Ensuring Cattle health activities by the CDVO through Mobile units/Temporary Health camps in the affected areas
- Ensuring that there is enough storage of food and pure water in the shelters. Monitoring all the activities in the affected areas.

## **Post Disaster**

### **Short-term Measures:**

- Formation of special task force with required equipment.
- Assigning responsibilities for specific areas.
- Emergency cleaning of debris to enable reconnaissance.
- Clearing fallen trees and branches from the roads to facilitate local relief work.
- Forming a work team carrying emergency tool kits.
- Deployment of towing vehicles, earth moving equipments, cranes,
- Construction of temporary roads.
- Keeping National & other Highways clear from disaster effects
- Assessment of damage.
- Temporary supply of food, drinking water and medicines to the shelters and affected areas
- Arrangement for safe shelter for animals.
- Providing the lighting facilities for shelter places.
- Deployment of home guards and constables to maintain law and order
- Providing temporary arrangements for income generation for the affected people
- Drought resistance short duration paddy seeds to be made available to farmers.
- Encouraging NGOs/INGOs from outside to carry out restoration and reconstruction works
- Ensuring crop insurance Supervising all the activities

### **Long Term Measures**

- Immediate restoration of Road communication, Irrigation system, Educational Institute, Govt. Institute, Electrical installation, Drinking water supply, Construction of IAY houses for the BPL families.
- Meeting with district level officials /Officials at Head quarter and chalk out emergency plan with vulnerable areas and resource list
- Co-ordination meeting of NGOs /PRIs. & Assignment of duties.
- Pre-positioning of staff in the likely cut off areas
- Arrange food and other basic requirement for emergency response.
- Collect information from different areas and to act accordingly. Co-ordination meeting with officials at Headquarters by 12 hours intervals and 24 hours intervals with the field officials.

- Regular collection of situations report of the risk and vulnerable areas from the officers assign for the purpose.
- Provision for administering emergent relief and the other basic needs Contact with SRC for supply of Temporary shelter materials.
- Keeping in touch with ADC (Relief) for supply of food articles procuring from FCI/Whole sellers
- Deputation of Volunteers to different probable affected areas.
- Helping the evacuees for returning to their houses.
- Immediate arrangement of free kitchen in the cut-off and inaccessible areas Relief distribution.
- Monitoring of Relief distribution. Provision of drinking water Provision of Medical facilities. Repair/Restoration of Roads.
- Transportation of Relief and Human Resources

#### **11.5.6.19 Addl. District Magistrate (A.D.M) /CEO, DDMA**

##### **Pre-Disaster**

Preparedness:

- Playing a second in command to the Deputy Commissioner in all aspects

Warning Dissemination:

- Ensuring proper dissemination of warning both downward and upward level improper interval of timing.
- Ensuring proper functioning of Control room Deployment of Office in charges of D.C in control room round the clock basis.

##### **During- Disaster**

Rescue and Evacuation

- Inform Specialized Search & Rescue Team
- Arrangement of Vehicles
- Keeping the Police and Fire Personnel ready
- Keeping staffs at the DEOC ready
- Deployment of additional staff if necessary

Distribution of Relief:

- Proper allocation of relief materials to the affected areas
- Allocation of officials for proper distribution of relief materials
- Supervision of relief distribution

**Post Disaster**

## Restoration:

- Keeping liaison with all line departments
- Restoration of roads, transport and communication systems
- Collection of progress report on restoration and reporting to the Govt/SRC/LAD
- Periodical visits to the affected areas to supervise the restoration works

## Distribution of Relief Materials:

- Procuring the list of the affected people and property from the C.Os & BDOs
- Preparing a comprehensive damage report
- Allotment of relief materials/financial assistance
- Monitoring to make sure that everything is at its place

## Coordination:

- Coordination with line departments and civil society organizations
- Supervision of restoration activities undertaken by different voluntary agencies.

**11.5.7 Roles & Responsibilities of different agencies/line departments during earthquake****11.5.7.1 Deputy Commissioner/ DDMA**

## Pre- Earthquake

- DDMA shall prepare District Disaster Management Plan including Response Plan for Earthquakes and update it every year.
- The DC on behalf of DDMA shall undertake all preparedness and mitigation measures as laid down in the NDMA guidelines on Earthquake Management
- DC/DDMA shall involve different agencies to undertake vulnerability assessment and conduct safety audit of schools, hospitals and other life line public buildings
- Based on the assessment shall direct the concerned agency to undertake adequate retrofitting measures to ensure safety of the vulnerable buildings.
- If necessary, the provisions of National Disaster Management Act 2005 may be invoked to ensure safety of the unsafe premises by barring entry of people into these places and issuing order to evacuate occupants from the vulnerable buildings.
- Awareness programmes on earthquake safety measures should be taken up by DDMA on a large scale.
- Capacity building programmes for Masons, Junior Engineers and Engineers on Earthquake Resistant Construction Practices, Doctors/Paramedics/Nurses on Mass Casualty Management to be organized for increasing the capacity of the stakeholders so that the risk is reduced.
- Earthquake drills will be conducted regularly by DDMA for testing the preparedness to respond

## During Earthquake

- Activate the District level Incident Response Team and the District Emergency Operation Centre (DEOC).
- Direct responses to the emergency as per the Response Plan
- Mobilize SDRF and if necessary, requisition NDRF and the Army to conduct Search & Rescue operations if required.
- Direct activation of all Hospitals Emergency Management Plan
- Send incident briefing to State HQ/SEOC regularly
- Open relief camps and shelter places as required
- Provide GR to the affected population

#### Post-Earthquake

- Conduct damage assessments through the Circle Officers/Committee constituted for the purpose and submit details of the damage to Government.
- Undertake rehabilitation work for the affected population
- Submit proposal for recovery and reconstruction to the Government under SDRF.

#### **11.5.7.2      *PWD(Building) / PWD (Roads)***

##### **Pre-Earthquake**

- Identify core teams for technical/engineering support/decision making in disaster situations
- Develop manuals and guidelines for safe construction practices
- Conduct training of staff in latest advancements of engineering, demolition techniques, health monitoring of infrastructure assets, seismic strengthening and retrofitting of buildings, critical infrastructure protection, DM
- Maintain inventory lists of all key equipment and tools in the state that can be mobilised for response and recovery efforts
- Integrate risk reduction as a component in design and construction practice of the department
- Identify weak lifeline buildings/roads and bridges and develop strategy for strengthening/retrofitting so as to minimize damage/disruption
- Undertake vulnerability assessment of buildings/roads and bridges and determine mitigation options
- Undertake checks to ensure infrastructure/roads and bridges remain in operational condition, should disaster occur
- Preposition emergency supplies and equipment/tools in high-risk concentration areas
- Undertake prevention/protection/structural rehabilitation measures retrofitting measures of lifeline buildings/ roads and bridges
- Ensure that all design and construction in the department are in compliance with the Indian Construction Codes of Practice (BIS) and the National Building Code



- 12. Work towards Performance Based Seismic Designs
- Preposition baily bridge and road clearance equipment in vulnerable places.
- 14. PWD (R) to identify roads that may be blocked by secondary disaster like landslides to ensure that communication not disrupted.

#### **During Earthquake**

- PWD (B) to provide assistance to DDMA in opening shelter places.
- PWD (R) to restore road communication.
- Mobilize resources for debris clearance operation.
- Direct department engineering cadre for emergency response operations
- Coordinate temporary repairs to buildings and related infrastructure
- Undertake damage assessment of buildings/roads and bridges and related infrastructure
- Undertake emergency repair and shoring of buildings/roads and bridges
- Undertake construction of temporary structures and supporting structures to provide basic services to the affected population
- Ensure controlled demolition and shoring up of buildings which have turned hazardous due to severe damage/tilting/settlement and the like

#### **Post-Earthquake**

- Participate in conduct of structural damage assessments
- Guide urban authorities and line agencies on structural repair works and package development of repair/reconstruction scheme for housing and related social infrastructure
- Undertake detailed damage assessment of buildings/roads and bridges
- Advise reconstruction/recovery of buildings and community infrastructure
- Coordinate, monitor progress and prepare report- repair, reconstruction and strengthening/retrofitting of buildings
- Prepare estimates and undertake repair/strengthening works
- Provide technical guidance/guidelines for construction of new buildings
- Supervise the civil work activities and ensure safe construction practices are streamlined during Recovery/Reconstruction phase

#### **11.5.7.3 Public Health and Engineering Department**

##### **Pre-Earthquake**

- Undertake conditional assessment of existing infrastructures
- Undertake risk assessment of the department facilities and cite recommendations
- Protect/strengthen the supply network with alternative/complementary source
- Undertake protection measures for the distribution of infrastructure (pumps, motors)
- Identify in advance emergency groundwater resources resistant to natural and man-made disasters that could replace damaged public and domestic drinking water supplies

- Train department engineers in DM
- Plan the movement of staff to disaster affected areas and delegate responsibilities
- Ensure restoration plans for damaged facilities
- Maintain emergency stock of supplies (pre-contract agreement with suppliers can be an add-on)

**During Earthquake**

- Provide immediate safe drinking water supply in disaster affected areas
- Provide immediate safe drinking water supply for conduct of response activities at hospitals, emergency shelters, schools designated as shelters and relief camps.

**Post-Earthquake**

- Help in the conduction of damage assessments
- Help in the management of shelter places and relief camps
- Submit proposals for recovery and reconstruction to the Government
- Undertake swift actions to restore damages lines

**11.5.7.4 Health Department****Pre-Earthquake**

- Prepare medical response plan and ensure preparation of Hospital Contingency Plans
- Retrofit or secure structural safety of Operation Theatre/Blood Bank/ICU.
- Conduct Hospital Mock drills
- Undertake hospital safety assessment and identify shortcomings/ gaps to be addressed
- Ensure emergency supply stock cater to peak demand
- Establish base for field hospitals along with basis/support services
- Impart skills and training to medical practitioners to function in disaster situations/post-disaster situations
- Work towards developing a cadre of volunteers trained in basic first-aid
- Impart skills and training for private medical practitioners/private sector hospitals/private pharmacy to function during disaster/post-disaster situation
- Conduct training of doctors, nurses and paramedics in trauma management and emergency response.

**During Earthquake**

- Activate medical response plan and Hospital Contingency Plans
- Designate triage area in field as well at the hospital premises for prioritizing patient management
- Activate Mobile Medical Response team
- Set up field hospital if required

- Provide basic medical assistance to the injured and who are in need of first-aid (pre-hospital care)
- Provide medical assistance to the relief camp inmates

#### **Post-Earthquake**

- Activate health surveillance systems to track down epidemic
- outbreak
- Conduct health camps
- Provide support in recovery operations
- Carry out impact assessment on health infrastructure
- Provide support to line departments in recovery and rehabilitation efforts of communities
- Provide support of experts for counselling of disaster victims, psychosocial support

#### **11.5.7.5      Guwahati Municipal Corporation**

##### **Pre- Earthquake**

- Support activities to undertake risk assessment of the city
- Incorporate/integrate DM concerns or hazard resistant constructions into process of: Land Use plan, Building byelaws, General development control regulations, City Development Plan, Master Plan
- Facilitate developing a robust response plan in urban areas
- Ensure enforcement of building byelaws and other regulation

##### **During Earthquake**

- Undertake rapid assessment of damage areas
- Ensure housing back people to homes that are determined safe
- Work with line agency for removal of debris
- Mobilize efforts for undertaking heavy urban search and rescue, medical care/mass casualty care
- Make provisions for sheltering the needy and minimize failure of basic services

##### **Post-Earthquake**

- Help in the conduct of damage assessments
- Help in the management of shelter places and relief camps
- Submit proposal for recovery and reconstruction to the Government
- Restore basic services
- Ensure provisions for temporary housing and implementation of R&R package for urban areas

### **11.6 City Disaster Mitigation Plan**

The points mentioned above should be part of a larger city or region level disaster management plan. The Disaster Management Act, 2005 has brought a change from Response & Relief oriented approach to proactive and comprehensive approach. This

has encouraged many Indian cities to develop and formulate a City Disaster Management Plan, the same should be worked for Guwahati Master Plan Area as well to enable it to be better prepared in the case of natural disasters in the future. As part of the Master Plan 2045 the authority feels there is a need for a CDMP for the planning area covering the following general principles: -

- Risk & Hazard Assessment
- Planning
- Organization
- Resource Utilization
- Need for Specialist
- Training

Generally, the CDMP prepared for the planning area should include sectoral plans covering the following aspects of disaster & emergency management: -

- Overall Preparedness
- Rehabilitation
- Emergency Response
- Prevention
- Mitigation
- Recovery
- Reconstruction
- Capacity Building Plans

Based on the above discussed general principles a detailed City Disaster Management Plan (CDMP) for GMPA have to be prepared for strengthening the institutional mechanism.

## **12. Spatial Strategy and Land Use Planning**

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### **12.1 Approach to Urban Planning**

The objective of preparing a Master Plan for the Guwahati is to integrate the functions of GMC as a cohesive entity with the rest of the planning area. The region excluding GMC is largely depends on the core municipal area to sustain. GMC provides the necessary impetus and drive for the development of conurbation and rural area. Guwahati, being one of renown business hub in Assam and also the linking neck among three major North-Eastern states viz. Mizoram, Manipur and Tripura it is required to understand the issues of the area surrounding the Guwahati city so that the entire GMPA is fully integrated.

Urban planning refers to the rational and judicious approach of allocating available land resources to different land using activities and for different functions consistent with the overall development vision / goal of a particular region. The main objectives of land use planning area

1. To promote efficient utilization and disposition of land ensure the highest and best use of land.
2. To promote desirable pattern of land uses to prevent wasteful development.
3. To preserve areas of ecological, aesthetic, historical and cultural significance.

In the chapter, it details out the visions, goals & planning concepts adopted for the preparation of GIS Based Master Plan for Guwahati Planning Area-2045. It then presents the guiding principles and strategies adopted for various sectors and the applications of planning theories & techniques. Later on, in the chapter it elaborates the Land use policies & growth centre models adopted. The chapter concludes a detailed explanation of the concept plan for the planning area prepared based on the strategies to achieve the overall visions & goals.

## **12.2 Vision, Goal and Objectives**

The Guwahati GIS Based Master Plan - 2045 is initiated with the aim of achieving a better economic growth, better infrastructure facilities, and higher quality of life for the planning area while keeping the heritage, culture and form of the city intact and preserving the environment of the area. To achieve these, it is essential to set out goals and adopt the planning concepts and guiding principles so as to ensure maximum benefits and least adverse effects. The discontinues & non-homogenous geographical profile of the planning area which is a historical accident has thrown several challenges towards ensuring continuity and proper planned development. Despite this limitation, through forethoughts & reasonable approach to the situation desired results could be achieved. This section elaborates the vision statement, goals that are formulated to achieve the goals and the planning concepts, which will guide to achieve the same.

### **12.3.1 Vision**

In the next 25 years, Guwahati will grow more than three million people and will consolidate its reputation as one of the Most Liveable; Socially Beneficial; Regionally Contextual; Environmentally Sustainable; Financially Viable; Institutionally Executable; Politically Acceptable and Culturally Prosperous areas in Assam for residents, business and visitors.”.

### **12.3.2 Goals**

The Vision for the planning area perceived around the following core ideas:

1. Preserving historical past, maintaining the liveability of the present, and transforming future through implementation of the highest quality planning, to enhance the level of infrastructure service to all people of Guwahati Region.
2. Develop a modern city that offers good quality, affordable and safe living environment with efficient mobility system.
3. Emerge as a dynamic place by unlocking the potential of urbanization for better economic, creative, cultural, social, and environmental outcomes.